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Toning Up an Organization

Under this title three articles are reproduced on another page which were received in the competition that closed January 1, 1916. These articles, judged to be the best of those submitted, came from J. A. Pack, chief clerk in the motive power department of the Chesapeake & Ohio at the Huntington (W. Va.) shops; John V. Le Compte, foreman, motive power department, Baltimore & Ohio, Baltimore, Md.; and Millard J. Cox, assistant superintendent machinery, Louisville & Nashville, Louisville, Ky. The competition, as far as the number of letters received is concerned, did not come up to either the apprentice or car inspectors' competition, which were held last fall. This proved a big surprise, for much attention has been given to organization problems in the mechanical department in recent years and we really expected to be deluged with material.

The Apprentice Competition

In our January issue, page 2, we had an extensive announcement of a competition for apprentices which is to close March 1, 1916. We want to know how the apprentice feels about the efforts which are being made to educate and train him for his life work? What things have proved most inspiring and helpful to him? What methods or practices in his course of training have made the greatest appeal to him? What can be done to make the course of training of greater practical value to him? Apprentices, or graduate apprentices, who have completed their courses since January 1, 1915, are eligible to take part in the competition. For the best letter on this subject, from a practical standpoint, which is received at our office in the Woolworth Building, New York, on or before March 1, 1916, and which does not contain more than 500 words, a prize of $15 will be given. For the next best article $10 will be paid. Other articles which may be accepted for publication will be paid for at our regular rates.

Slack and Draft Gear Maintenance

That bug-a-bear—Slack! It causes break-in-twos, damaged freight, wrecked equipment and many a "Scotch blessing" from the road men, the officers and the shippers whose goods are damaged. Why not humor the beast? Any kind of draft gear, whether spring or friction, cannot be expected to perform its proper functions unless it is properly maintained. It has important work to perform—it must keep the slack to the proper amount and it must absorb the shocks incident to car movements. Unless it does these things it is not worth much more than the old link and pin connections of years ago. The fact that a highly improved and expensive draft gear has been placed on a car does not mean that the car will forever more be immune from the ravages of rough handling. It should be maintained the same as any other part of a car or locomotive. We will grant that it takes time and money properly to inspect the draft gears of every car and make repairs, but because of the trouble caused by excessive slack and the damage caused by ineffective draft gears, such labor and expense will be amply justified. The next time the lamentations are heard, why not seek the root of the trouble; repair the gears and give them a chance to show what they can really do?

Fuel Economies at Stationary Plants

Fuel is fuel no matter whether it is used on a locomotive or at a stationary boiler plant. It costs money wherever it is used. The fact that, comparatively speaking, but little is used at stationary plants does not mean that they are not worthy of inspection and improvement. That over 600 lb. of scale has been removed from a railroad stationary boiler by the application of a patented flue cleaner indicates that in some cases the supervision of stationary boiler plants is notoriously weak. Another instance might be mentioned of a plant operating in a bad water district. Excessive boiler trouble led to an investigation of the plant; an analysis of the boiler water after two successive "blow downs," two gages being blown out each time, showed 304 grains of incrusting solids. The feed water had been treated (?) and contained 35 grains. This boiler now operates with less than two grains and boiler troubles have been materially reduced. It is well known that scale is a poor conductor of heat. Why wait until it makes its presence known through the coal bill? A dollar saved at a stationary plant is as good as the dollar earned in carrying traffic. The work can be done at a small expense and the returns will make it well worth while.

Passenger Car Terminal Competition

One exceedingly important part of the work of the car department has never received much recognition either in the railway technical publications or in the proceedings of the various mechanical department associations. Just why this is so it is difficult to understand, because it is one of those features which have much to do with the convenience, comfort and health of the traveler, and therefore merits prime consideration. It is the organization and methods of handling a passenger car terminal yard, first, so that the equipment may be made clean and sanitary and the supplies be properly replenished in order to please and protect the traveling public; and secondly, that the work may be carried on efficiently and economically. The work which is handled by the passenger car terminal force is a most difficult one and is often seriously complicated by stormy weather and delays to important passenger trains. The organization must have sufficient elasticity so that these difficulties may be overcome without neglecting the equipment or interfering with schedules. To place this subject on record and encourage as many of the car department foremen as possible to give us the benefit of their experience and views, we will give a prize of $35 for the best article, from a practical standpoint, which is received in our offices in the Woolworth building on or before April 1, 1916. A second prize of $25 will be given for the next best article, and others that are accepted for publication will be paid for at our regular rates. It is not necessary, in order to qualify, to discuss the subject in all its phases, or in its entirety. If you have had special experience along one line,

such, for instance, as the methods or details of the actual cleaning of the equipment, or looking after the supplies, or laying out a terminal yard in order that the work may be handled to the best advantage, or improving or perfecting the form of organization to insure the best results, or any one of a number of other different phases of this question, write about the particular thing with which you are most familiar. Remember that your personal co-operation, no matter to what extent you cover the subject, will be greatly appreciated by the editors and may be extremely helpful to your fellow workers on other roads as well.

Cost Versus Service

Innumerable are the opportunities for reductions in maintenance costs by a constant and careful analysis of methods, materials and new devices. Those mechanical departments which make an organized effort constantly to improve shop practices, details in locomotive and car construction and methods of handling equipment, are fully repaid for their efforts. With the ever-increasing ingenious devices placed at the disposal of the railways by the railway supply companies, the man who believes that the practices which proved satisfactory yesterday should answer for today is as valuable to his road as the old wood burners of years ago are to the railroad of today. Money spent for investigations and tests are sure to prove profitable investments in the long run. "Cost versus Service" should be the watchword. The fact that block tin has been used for lining crossheads for the past twenty years does not mean that a composition metal might not prove more economical, even though the crossheads have to be relined more often. Improved shop machinery and locomotive appliances and direct outlay of money for education of the employees all represent an expenditure that will give splendid returns on the investment. Men competent to make careful investigations, whether it be the mechanical engineer, the engineer of tests, or a special representative of the head of the mechanical department, should be placed in charge of this work.

Feed Water Heater Question

H. H. Vaughan, in addressing the American Society of Mechanical Engineers a little more than a year ago, made this statement: "This is a subject (feed water heaters) which American railroad people have largely neglected. It has the advantage of not only saving in coal, but increasing the capacity of the boiler. In careful experiments we found an economy of 12 per cent in the use of the heater * * * ." For many years railroad officers have looked for a device of this kind, that locomotives might be operated more economically. Hundreds, possibly thousands, of experiments have been made, and many different designs have been tried out and discarded. Yet today this device has not passed the experimental stage in this country. The Prussian State Railways are said to have several thousand locomotives equipped with a type of feed water heater that gives something less than half the saving mentioned above.

As limitations of locomotive weight and size are being reached, and it is still desirable in many cases to make further increases in capacity, progress in the development of the device may be forced more because of this than because of the greater economy which may result from its use. The problems which confront the designer in developing a satisfactory feed water heater are most difficult ones, and their final solution may go hand in hand with other developments which could not be foreseen in the earlier stages of experimentation. In not a few cases attempts have been made to heat the water in the tender tank with the air-pump exhaust. Progress in this direction has been limited by the inability of the injector to handle water beyond a certain critical temperature and by the bursting of hose connections. The use of pumps instead of injectors and of flexible metallic connections between the tender and locomotives may overcome these difficulties, if the improved economy and capacity can be found to justify these changes.

Certain types of heaters have failed because of the water conditions. There are many things in connection with the treating of feed waters which are not thoroughly understood, and the development of the feed water heater may be hastened with their solution. Then, too, if certain types of locomotives should be fitted with a draft or blower device, such as has been designed by H. B. MacFarland, of the Santa Fe, some of the exhaust steam may be used for feed water heating purposes with good results. With many minds at work on the problem, and the knowledge gained from previous experiments, it would not be surprising if a distinct advance step was taken in the development of a successful device in the near future.

Increased Locomotive Capacity

Frequent reference is made in these days to the rapid growth in size and capacity of locomotives. The table herewith appended shows the average tons of freight per train mile, for each of the past six years, for a number of typical roads in various parts of the country. These figures are taken from the annual reports of the respective companies and, except where otherwise noted, are for the total freight carried, company and revenue. To some extent the figures reflect the growth in capacity of the modern freight locomotives; in most cases part of the increase in tonnage was made possible by the elimination of grades or curvature and by other engineering improvements or by the adoption of better operating practices. Remarkable results in some cases have followed campaigns of education, in which attempts were made to reach every employee who was at all concerned, or who could be helpful, in improving car or train-loading. In most instances, however, newer and larger locomotives, or the modernization of old power by the addition of capacity improving devices, has been an important factor in bringing about the larger average trainload:

Road	1915	1914	1913	1912	1911	1910
Atchison, Topeka & Santa Fe	442	420	425	340	395	389
Baltimore & Ohio*	692	645	620	554	441	442
Boston & Maine*	333	314	292	265	247	247
Buffalo, Rochester & Pittsburgh	707	694	710	647	635	638
Canadian Pacific	463	464	440	431	389	390
Central of Georgia	360	347	348	328	329	312
Chesapeake & Ohio	962	927	901	788	689	733
Chicago & Alton	454	479	516	455	426	421
Chicago, Burlington & Quincy	492	479	484	438	406	381
Chicago Great Western	574	512	484	434	422	343
Chicago, Milwaukee & St. Paul	459	454	415	355	319	322
Chicago, Rock Island & Pacific	380	362	356	330	320	297
Cincinnati, Hamilton & Dayton	649	637	631	533	455	454
Denver & Rio Grande	433	390	345	299	292	296
Great Northern*	650	663	635	601	524	518
Hocking Valley	1,068	1,036	1,023	883	759	674
Kansas City Southern	582	545	554	462	426	404
Lehigh Valley	644	617	621	588	564	562
Louisville & Nashville	347	297	295	285	275	278
Missouri Pacific	484	451	437	397	348	347
New York, New Haven & Hartford*	333	304	291	292	290	293
Norfolk & Western*	841	802	764	694	643	635
Pere Marquette	498	459	450	367	343	346
St. Louis & San Francisco	378	351	324	298	265	267
St. Louis Southwestern	345	338	349	341	320	326
Southern Railway	382	339	321	309	301	296
Southern Pacific	464	471	461	456	474	476

* Revenue freight only.

Conditions are such that the roads will be forced to make still greater improvements in the direction of larger trainloads if they are successfully to overcome the handicaps of adverse legislation and unwise regulation and the increasing costs of both labor and material. Motive power officers should not overlook even the slightest opportunities for suggesting improvements looking toward the better use of or increased capacity of locomotives now in service, for even if the railroads could afford to buy all the new and modern power they would like to have, it would be only a small percentage of the total power now in service, and it is this power that will have to handle the bulk of the traffic for the next few years.

In the fiscal year 1915 the railroads reduced their operating expenses about $186,000,000. About half of this reduction was in maintenance expenditures, much of which probably represented deferred maintenance. The other half of the saving was

in transportation expenses, a large part of which was probably due to better car loading and larger trainloads. An important item in securing better train-loading is the importance of power in first class condition. Locomotives cannot be consistently worked near the limit of their capacity, day in and day out, unless they are kept in prime condition. This can only be accomplished by a highly developed organization, with plenty of supervision, so that every detail may be watched closely and repairs may be anticipated by giving attention to excessive wear or slight defects before trouble develops. The mechanical department officers should never lose sight of the fact that their important function is to keep the power and equipment in such shape that the operating department may use it to the very best advantage in the way of securing more efficient and economical operation.

The Crying Need of the Car Department

Is it not time for the railroads generally to take a more decided stand in providing for the education and training of employees in the car department? A few are doing fairly good work in this respect. Some have tried and failed; others, the great majority in fact, have done practically nothing. The responsibilities of the car department and the demands made upon it have increased greatly in recent years and promise to grow steadily. The increase in capacity of freight cars, the stronger designs made necessary by more severe service because of increased trainloads and abuse in terminal yards, the added complication of interchange rules, the necessity for giving more attention to the protection of freight, the requirements of the United States safety appliances act, and numerous other important factors, have enlarged and complicated the work of the department to such an extent that it is absolutely necessary to provide for the development and training of men successfully to carry on its work.

One apprentice instructor remarked a short time ago, "We can't keep car apprentices on our road. They leave for more attractive work elsewhere, or go into the locomotive department." The car department cannot afford to let young men leave in this way and must take decided steps to encourage ambitious boys to go into this work. In the annual report of the Division of Safety of the Interstate Commerce Commission, which appears elsewhere in this issue, two suggestions occur which are of special interest in this connection. In commenting on the necessity for increasing the braking efficiency of freight cars the report states: "Working toward this end it is gratifying to note that the carriers are educating their inspectors in a more efficient discharge of their duties and are securing men who have a better knowledge of the complicated brake systems and the problems in maintaining them." Again, later in the report, the statement is made that, "several of the railroads have general traveling inspectors who go from one inspection point to another consulting with the inspectors and repairmen, ... The results of this educational method have been most gratifying, etc."

The railroads are, of course, in competition with industrial concerns in securing men, and in order to get the type of men that can make good in looking after the more important work in the car department they must meet this competition. Then, too, they must meet the task of educating and developing their own men, and doing this in such a way as to attract a good class of young men and encourage them to persevere by seeing that opportunities for advancement open before them. At the Master Car Builders' convention in 1912, M. K. Barnum, in discussing car department apprenticeship, made this statement: "I believe the apprentice should start in with the understanding between him and the management that he will be given a chance to learn the business of the entire department, and I believe that a schedule should be arranged which he can look over before he starts work and see what he is going to learn; see what opportunities he will be given. The schedule should cover everything in the car department, all the more important parts of the work from that of repairing a freight car truck, putting in a brass, packing a box, up to such cabinet work as his skill and ability will enable him to do properly." If Mr. Barnum's advice was followed it would do much to attract young men to the service.

Those who have read carefully the contributions to the car inspectors' competition, which have been printed in the last few issues of this paper, must realize the importance of doing more to train men to meet fully the requirements of this exacting position. Even the Master Car Builders' Association is weak in outlining the requirements for a car inspector in its recommended practice. The practical experience which such a man must have is dismissed in two short sentences: "One year at oiling cars. Two years at car repairing." A man who can successfully hold such a position ought to spend *at least* as much time and intelligent effort in studying and training for it as does a machinist apprentice on a road having a first-class modern apprenticeship system. The Master Car Builders' Association ought immediately to take some steps to use its influence in remedying the deplorable conditions which now exist in the lack of attention to this important subject.

NEW BOOKS

General Foremen's Association Proceedings. Edited by William Hall, secretary of the association. 269 pages. 91 illustrations. 6 in. by 9 in. Bound in paper. Published by the association, William Hall, secretary, Winona, Minn.

This book is the official report of the eleventh annual convention of the International Railway General Foremen's Association, which was held at the Hotel Sherman, Chicago, Ill., July 13 to 16, 1915. It contains the following papers, with the accompanying discussions as presented at the meeting: Valves and Valve Gearing; Rods, Tires, Wheels, etc.; Shop Efficiency; Roundhouse Efficiency and Oxy-Acetylene Welding. The paper on Valves and Valve Gearing is one of the most complete ever presented to the association, which, with the very thorough discussion that was given the subject, occupies over 100 pages in the proceedings.

Laboratory Test of a Consolidation Locomotive. By E. C. Schmidt, J. M. Snodgrass and R. D. Keller. 130 pages. 57 illustrations. 6 in. by 9 in. Bound in paper. Published by the University of Illinois, Urbana. Price 65 cents.

This book is published as Bulletin No. 82 of the Engineering Experimental Station of the University of Illinois, and presents the results of a series of laboratory locomotive tests, which constitute the first work of the recently established locomotive testing laboratory of the University of Illinois. The tests were made on a typical consolidation locomotive loaned to the University of Illinois by the Illinois Central. Since this is the first series of tests conducted in the new laboratory, the bulletin includes a description of the laboratory equipment and the methods of testing employed.

The locomotive was first tested in the condition in which it was received from service. It was then subjected to certain repairs, and again fully tested. The main purpose of the tests was to determine the general performance of the locomotive and the performance of its boiler and engines after the repairs were made and when the locomotive was in excellent condition. The secondary purpose was to study the effect of some of these repairs upon the locomotive's performance. The maximum amount of dry coal fired per hour was 11,127 lb. or 224.5 lb. per square foot of grate per hour. The maximum equivalent evaporation per hour was 57,954 lb. or 17.65 lb. per square foot of heating surface per hour. The University of Illinois equipment makes possible the collection of all stack cinders and the information relative to cinder losses which is presented shows these losses to have ranged from 3 to 16 per cent of the weight of the dry coal fired for what might be considered ordinary service conditions and to have amounted to 27.4 per cent of the weight of the dry coal fired during one test under extreme conditions of firing and draft.

COMMUNICATIONS

KINGAN-RIPKEN VALVE GEAR DEVICE

Detroit, Mich.

To the Editor:

I have read with interest the description of the Kingan-Ripken valve gear in the August issue of your paper. While the advantages of a sharp admission are well known, it would seem from a little consideration that they were attained at the expense of the distribution in back gear; or, to be more precise, while the action in forward gear is to accelerate the admission, in back gear it is correspondingly retarded. This I proved several years ago by layouts and a wood model which I think I still have.

To what extent the action in back gear would interfere with its use would depend on the class of service it was used in; if in main line passenger work, it would seem to be at its best, as there is comparatively little work in back gear and that mostly to and from the roundhouse.

Winthrop Gates.

Minneapolis, Minn.

To the Editor:

Mr. Gates is right in stating that the increased efficiency due to the Kingan-Ripken main rod attachment is attained in the forward gear at the expense of the back gear. It has been and is a common practice to sacrifice the back for the forward gear in practically all gears applicable to locomotives.

As about 99 per cent of the earnings of all locomotives outside of switch engines are attained with the engine in the forward gear, it would appear that any device that tends to increase the earning power of the modern high priced locomotive to the extent that our device has is a very desirable thing to have on a locomotive.

This is attained without any additional parts or complications on a style of gears which, because of reliability and easy maintenance, are very desirable for railway locomotive service, yet do not give the efficient distribution of steam needed in the large engines of today.

While it is true that the back gear is sacrificed for the forward, any engine equipped with our device is still capable of backing a train to the extent necessary in road service. This has been proven in the larger number of engines equipped. We do not recommend the device for switch engines.

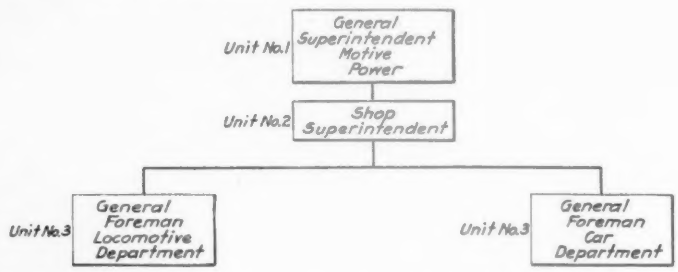
Kingan-Ripken.

AN OFFICE KINK

Burnside Shops, Chicago.

To the Editor:

Shop kinks are numerous, but office kinks are somewhat scarce. In this office we have a scheme which may be of some value to others, and can easily be explained.



Unit 1 writes a letter to No. 2, raising a question. Unit 2 must of necessity question Units No. 3 to get the necessary information. Unit 3 investigates and reports to No. 2, who in turn gives the information to No. 1. In other words, there is a continuous repetition going on.

Our idea is for Unit 3 to address reply to No. 1, sending it to No. 2 for signature; and Unit 2 permits the letter, if correct, to go to No. 1. A carbon copy of No. 3's letter is forwarded to No. 2 for file protection.

We find that this relieves not only the work of stenographers in office of No. 2, but saves considerable time for those dictating and handling mail in No. 2's office. This system has worked out with good results, and I thought possibly it would be of interest to others.

A. J. Gibney,
Chief Clerk to Shop Superintendent.

FLAT WHEELS

New York, N. Y.

To the Editor:

Below is a copy of a letter that a leading American railroad sent out to trainmen and section foremen with reference to flat wheels:

TRAINMEN AND SECTION FOREMEN:—

We are giving you below information as to the hammer blow from flat spots on car wheels. During the past three winters we have had considerable to say on flat spots, and we believe that after reading the following article, you will readily see why we have felt so much anxiety as to dangers arising from this cause.

THE IMPACT OF FLAT SPOTS
ON CAR WHEELS

The impact resulting from flat spots on railroad wheels under different loads and at different speeds is being studied at a western university, by means of an instrument that records the force of the blow photographically. In these tests, which cover flat spots of various lengths, it has been found that a wheel with a flat spot three inches long strikes a blow of 104,000 lb. with the car going at sixteen miles an hour and carrying a load of 20,000 lb. Under similar conditions a flat spot one and one-half inches long produces a blow of 20,000 lb., and a flat spot two inches long a blow of 25,000 lb.

I presume the letter had the desired effect in that it bewildered the trainmen and foremen into the idea that our universities do wonderful work, and there is something profound in the mathematics of impact. One section foreman, for instance, exclaimed, "My! my! my! 104,000 lb.!" after reading the letter.

Just to learn how he understood the letter I asked him what a blow of 104,000 lb. meant. He started to explain with a 10-pound spike maul. He started a track spike into a tie, tapping it gently at first with "blows of 10 pounds" each, at first, and then increasing his swing in the usual way he drove it home. After finishing the job he scratched his head dubiously and agreed that it "didn't look quite right." His last blows were surely heavier than the first, he asserted.

So, after the demonstration, and after a few moments of thought, this foreman no longer understood what a "blow of 104,000 pounds" is.

As for myself, I have studied engineering, mechanics, physics, etc., somewhat, and have even gone so far as to attempt teaching engineering subjects. Yet I, a college graduate, do not understand the letter.

Perhaps a blow of one pound means "the impact resulting from the fall of a one-pound weight through a height of one foot," or one inch, or something like that. If so, should it not have been explained to the trainmen and foremen?

N. G. Near.

A PLEA FOR THE DRAFTSMAN

Washington, D. C.

To the Editor:

I have read with much interest the numerous letters on the status of railroad clerks that have recently been published in the Railway Age Gazette. I should like to say a word concerning a class of men whose condition at present seems to me to be fully as unsatisfactory as that of the clerks: I refer to the draftsmen in the mechanical department.

The whole force in a drawing room is to a great extent sidetracked, so far as advancement to the higher positions on the road is concerned, but that is no reason why those in charge of a drawing room should not try to make the work interesting and attractive for the men under them. Any work of this kind is bound to be more or less monotonous, and the fact

that it demands close attention and extreme accuracy makes it tiresome, even for those long accustomed to it. Usually the chief draftsman takes the attitude that the men under him are not worth bothering with, for he knows that they are not usually of the timber from which officers are made; but granting that this is true in most cases, it is no reason for "rubbing it in," instead of giving the men some much-needed encouragement, and telling them once in a while that their work is in many ways one of the most important in their department.

Be sure that the chief draftsman takes on interest in the work of the men under him. Let him work with the men, so to speak, and decide what class of work each man is best fitted to perform. Some men are not as good as others at laying out new work, some are better at a quick job requiring but little accuracy, while still others are good at working out intricate details. Above all things let the men remember that the drawings are the plans for which a real, concrete piece of machinery is to be constructed. Teach them to think in terms of the finished product, not in terms of the drawing board.

If the plans for a new locomotive are gotten up in the office, when the new engines arrive in the yard, make it a part of the duty of the men who worked on those drawings to go down and see how the thing looks when finished. It will take them off the board for a short time, but it will be money back for the company in the end. The men will keep in touch with the actual railroad end of the business, and feel themselves a part of the whole system, a feeling which comes more naturally to the men on the road than to those whose time is spent in the office. I think if once a month one of the men could be sent off for a week to inspect some piece of work on the road it would do a lot towards making a more contented, wide-awake and efficient drafting force. HUGH G. BOUTELL.

VALUE OF ATTRACTIVE SHOP GROUNDS

MACON, Ga.

TO THE EDITOR:

We try to keep the shop premises at Macon neat and attractive, as illustrated by the photographs which show some of the parks and flower gardens. The grounds are kept in this condition with but very little expense, only one cheap laborer being

Grounds in Front of the Master Mechanic's Office

assigned to this particular work. Foremen of the different departments take great interest in their flowers, each department having its own garden.

One of the photographs shows the grounds in front of the master mechanic's office; another the park at the north end of the erecting shop, where all employees of locomotive department pass to and from work; and the third a flower garden on the east side of the smith shop.

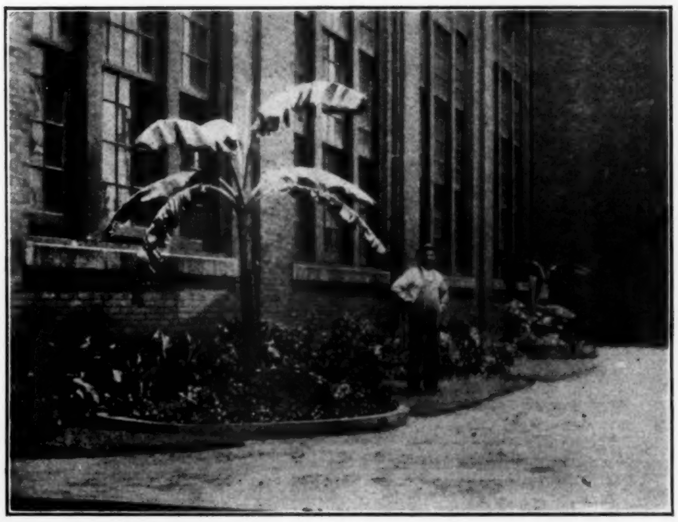
There are a number of other equally attractive spots, which are not shown. All the spare ground is sodded and kept well

Park at North End of Erecting Shop

trimmed. We also have a greenhouse built of scrap material from old buildings, where the plants are kept through the winter, new plants rooted, and seed sown for early plants.

The absence of these parks and flower gardens would invite the accumulation of rubbish, scrap piles, and other eyesores around the shop grounds. Shop premises kept up in good, attractive condition make the employees better satisfied, resulting in better service.

While the shop grounds are being beautified and kept in a neat condition, we should not lose sight of the fact that it is



Flower Garden at East Side of Smith Shop

just as important, or more so, to keep a clean shop where the men can carry on their work without being crowded or climbing over piles of junk. We give the inside of the shops just as much attention as the grounds; in fact, we give the whole premises our careful attention. C. L. DICKERT,
Assistant Master Mechanic, Central of Georgia.

TESTING FOR FLASHPOINTS.—Flashpoint may be found in a simple manner by heating a few ounces of oil over a gas flame and trying a lighted match over the surface of the oil until a wave of flame is seen to flash across its surface. The temperature of the oil when this occurs is called its flashpoint. Oils whose specific gravities are below 0.85 generally have flashpoints below 60 deg. F., while those of which the specific gravities exceed 0.85 usually have higher flashpoints.—*Power*.

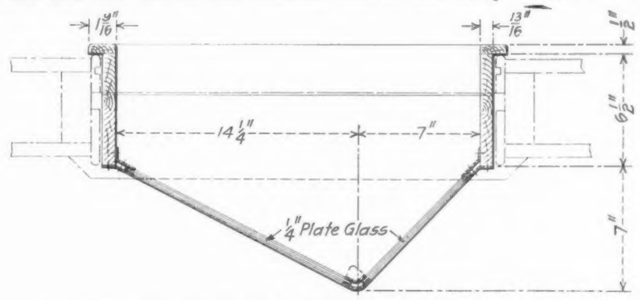
SOUTHERN RAILWAY DYNAMOMETER CAR

Latest Development in Dynamometer Car Design;
200,000 Lb. Capacity. Seventeen Records Obtained

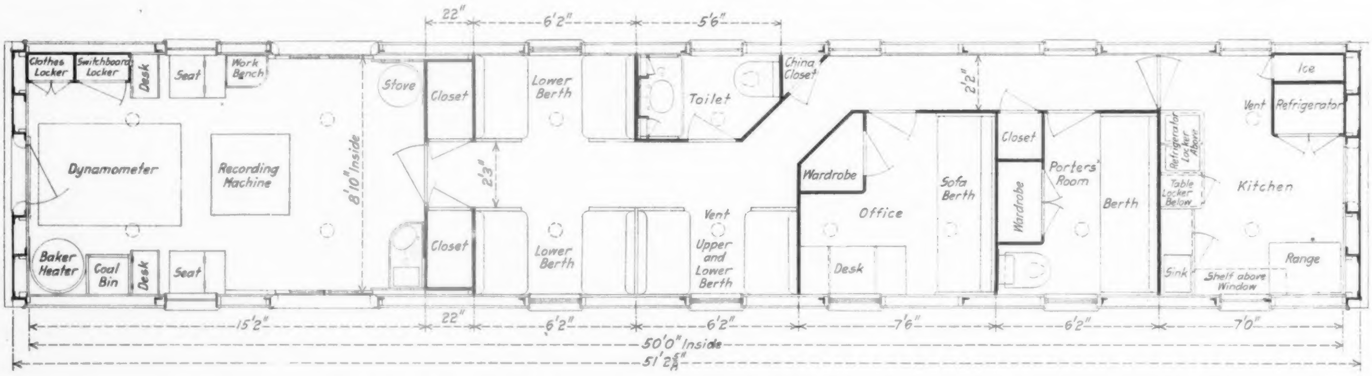
The Southern Railway has in service two dynamometer cars, each having a registering capacity of 200,000 lb. draw-bar pull and 800,000 lb. buffing force. The body of the cars were built by the Lenoir Car Works and all of the dynamometer equipment was furnished and installed by the Burr Company, Champaign, Ill.

CONSTRUCTION OF CAR

The cars are 50 ft. long by 8 ft. 10 in. wide inside, the dynamometer room at one end of the car being 15 ft. 2 in. long. The rest of the car is divided into compartments for housing the testing crew, there being three lower and one upper berth, an office with a sofa berth, a room for the porter and a kitchen equipped with a range, refrigerator, etc. The car is heated with hot water from a Baker heater. Rolling side doors are provided at both sides of the car in the dynamometer room, a small door, 4 ft. high is provided in the kitchen end, and a high door is provided on the dynamometer end. A special observation window, as shown in the illustrations, is placed in each side of the car. This window projects 7 in. beyond the side of the car so

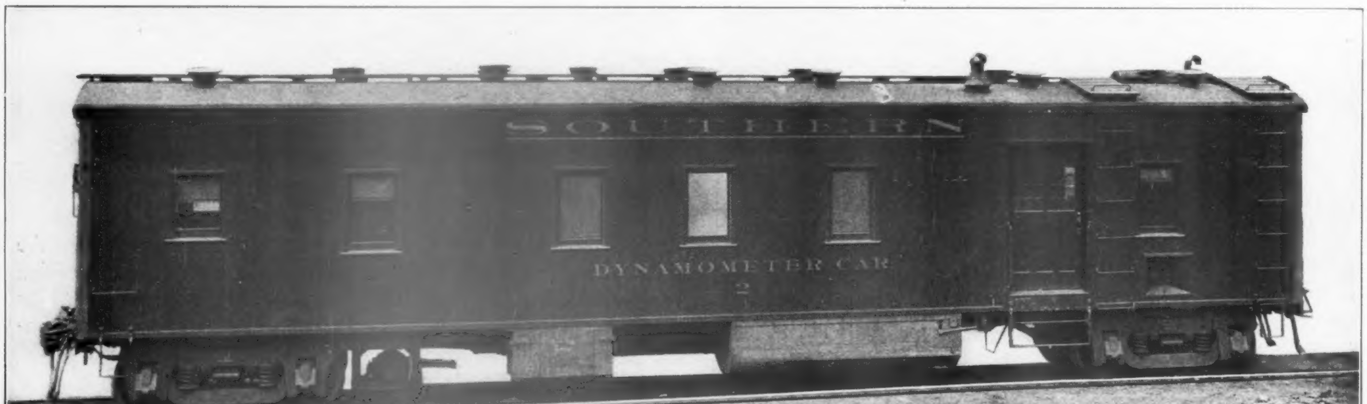


Horizontal Section Through the Observation Window



Floor Plan Showing the Interior Arrangement of the Dynamometer Car

that the observer may readily see the approaching landmarks. Directly below this window is the mile-post light box set into the car at such an agle that the light may be thrown sufficiently

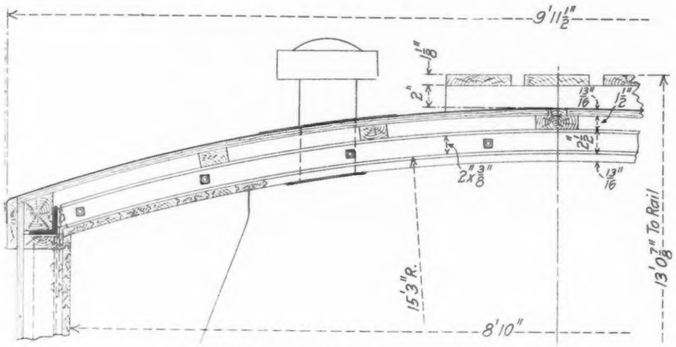


Dynamometer Car for the Southern Railway

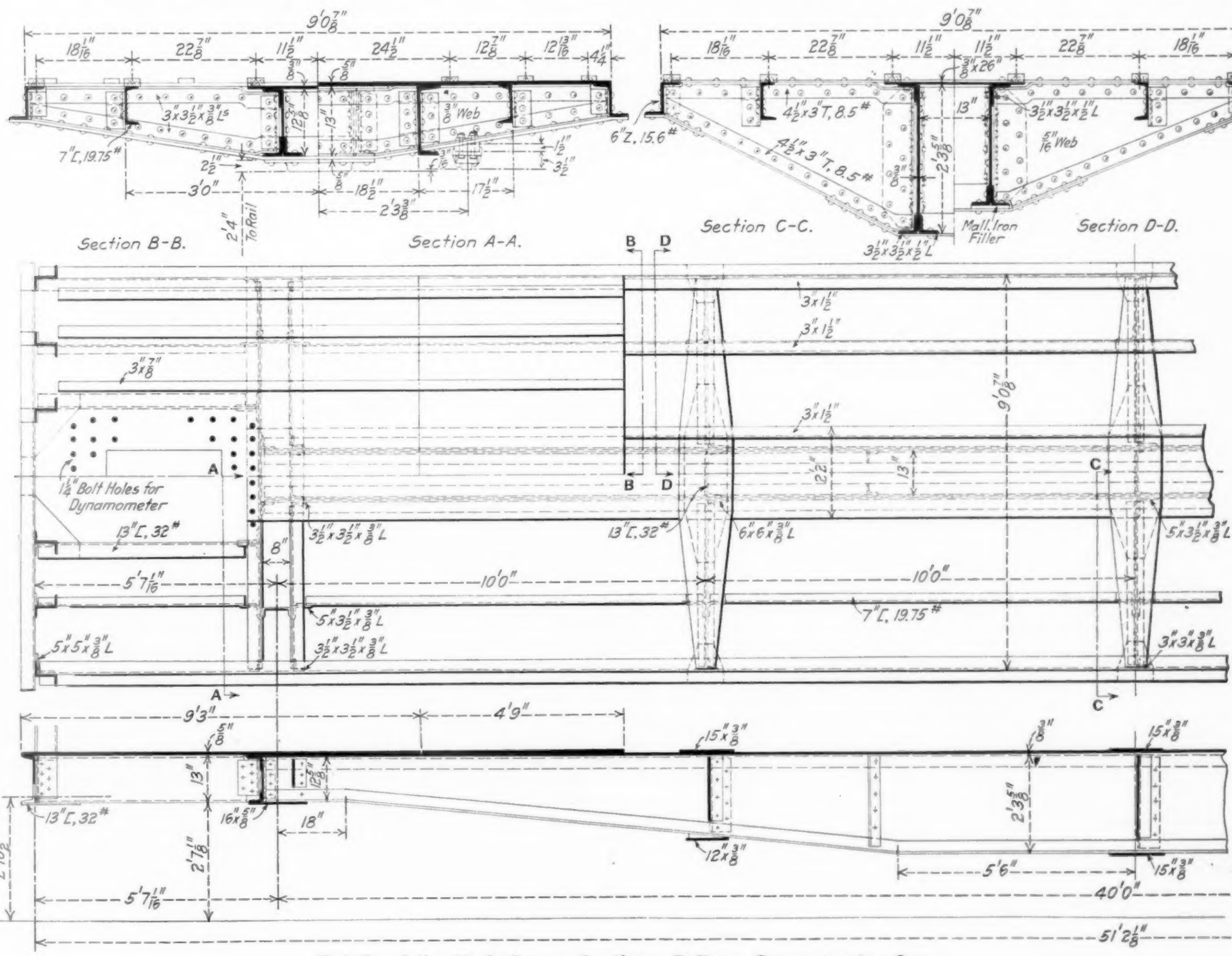
far ahead for the observer to discern the landmarks as they are approached in the dark.

The under frame is of the built-up type, being made of structural steel shapes. The center sill is a box girder of the fishbelly type with bottom plates only at the cross-bearers and bolsters. The distance between the webs is 13 in. and the depth is 2 ft. 3⅝ in. at the center and 12⅝ in. at the ends. It extends from the end sill at the kitchen end to the body bolster at the dynamometer end of the car, the dynamometer rigging being installed between the bolster and the end sill. It is made with a 3½-in. by 3½-in. by ½-in. angle at the outside top of a ⅜-in. web plate and an angle of the same size at each side of the bottom. It is covered with a ⅜-in. top cover plate 2 ft. 2 in. wide, extending the full length of the girder. Two intermediate sills of 7-in., 19.75-lb. channels extend between the cross members of the underframe for the full length of the car. At the dynamometer end 13-in., 32-lb. channels located 18½ in. each side of the center of the car extend between the end sill and the body bolster to take the place of the center sill, which terminates at the body bolster.

The side sills are 6-in., 15.6-lb. Z-bars, and extend the full length of the car. Three cross bearers are used, one at the middle of the car and one 10 ft. from the middle toward each end. They are made up of 4½-in by 3-in., 8.5-lb. T-bars, which run from the side sill to the top and bottom of the center sill, a 5/16-in. web and a ⅜-in. top cover plate, 15 in. wide at the center, which extends from side sill to side sill. A bottom cover plate of the same material extends part way up the bottom T-bars. The webs of the cross bearers are fastened to the web of the center sills by one 6-in. by 6-in. by ⅜-in. angles. A 13-in., 32-lb. channel is riveted between the webs of the center sill at each cross bearer.



Details of the Roof Construction



Details of the Underframe, Southern Railway Dynamometer Car

The body bolsters are of the double type, spaced 8 in. between webs. They are made up of 3-in. by 3½-in. by ⅜-in. top and bottom angles, a ⅜-in. web and a 16-in. by ⅝-in. bottom cover plate. At the dynamometer end a ⅝-in. cover plate extends back from the end sill 9 ft. 3 in. for the full width of the car, and immediately back of it is another plate of the same material, 4 ft. 9 in. long. This provides a substantial base for the recording table. The end sills are 13-in., 32-lb. channels.

The framing is made principally of steel shapes, 2½-in. by 2½-in. by ¼-in., angles being used for the side posts and diagonal braces and 6-in., 15.6-lb. Z-bars for the corner and end posts. The side plates are 3-in. by 3-in. by ⅜-in. angles, and the end plates are 4-in. by 3-in. by ⅜-in. angles. The carlines are made up of two 2-in. by ⅜-in. bar iron straps, between which is bolted a strip of wood 2½ in. by 1¼ in. to which is nailed the purlins and the car ceiling. The straps are flanged and riveted to the side plates. The flooring consists of a layer of 1⅛-in. and a layer of ¾-in. boards, between which is placed a layer of ⅛-in. felt paper.

DYNAMOMETER TRANSMISSION

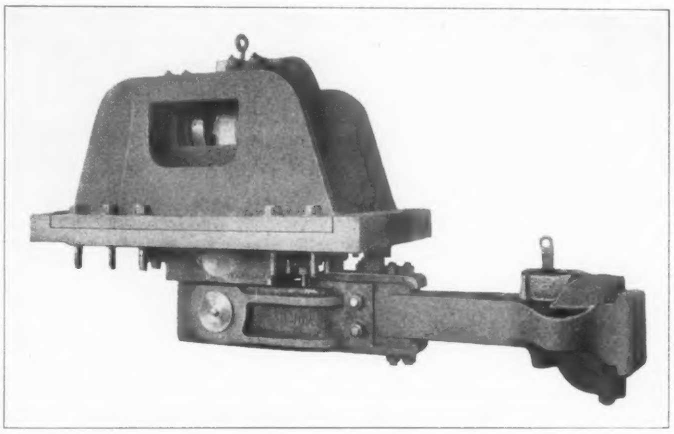
The dynamometer mechanism is driven from the rear axle of the leading truck, to which is keyed a 36-tooth gear. This drives another gear of the same size which runs on a splined jack shaft, the entire mechanism being enclosed and running in an oil bath. By shifting this gear in and out of mesh with the axle gear, the dynamometer mechanism is thrown in and out of action. A worm on the jack shaft engages with a worm wheel which drives the main shaft, the shaft being fitted with universal and slip joints to accommodate the movement of the truck. The drive is carried to the transmission case through bevel gears. A right and left spring ratchet clutch at the head of the vertical driving shaft in the transmission case provides a constant direction drive to the paper, regardless of the direction in which the car is traveling. Provision is also made for cutting out the axle drive and cutting in the motor drive, a 32-volt

¼ h.p. motor running at 1,200 r.p.m. being used for the purpose. The transmission gears provide three speeds of paper travel, which are 1/16 in., ¼ in. and 1 in. per 100 ft. of car travel when driven from the axle, and 3¾ in., 15 in. and 60 in. per minute when driven by the motor. The transmission gears are lubricated by a continuous bath of oil.

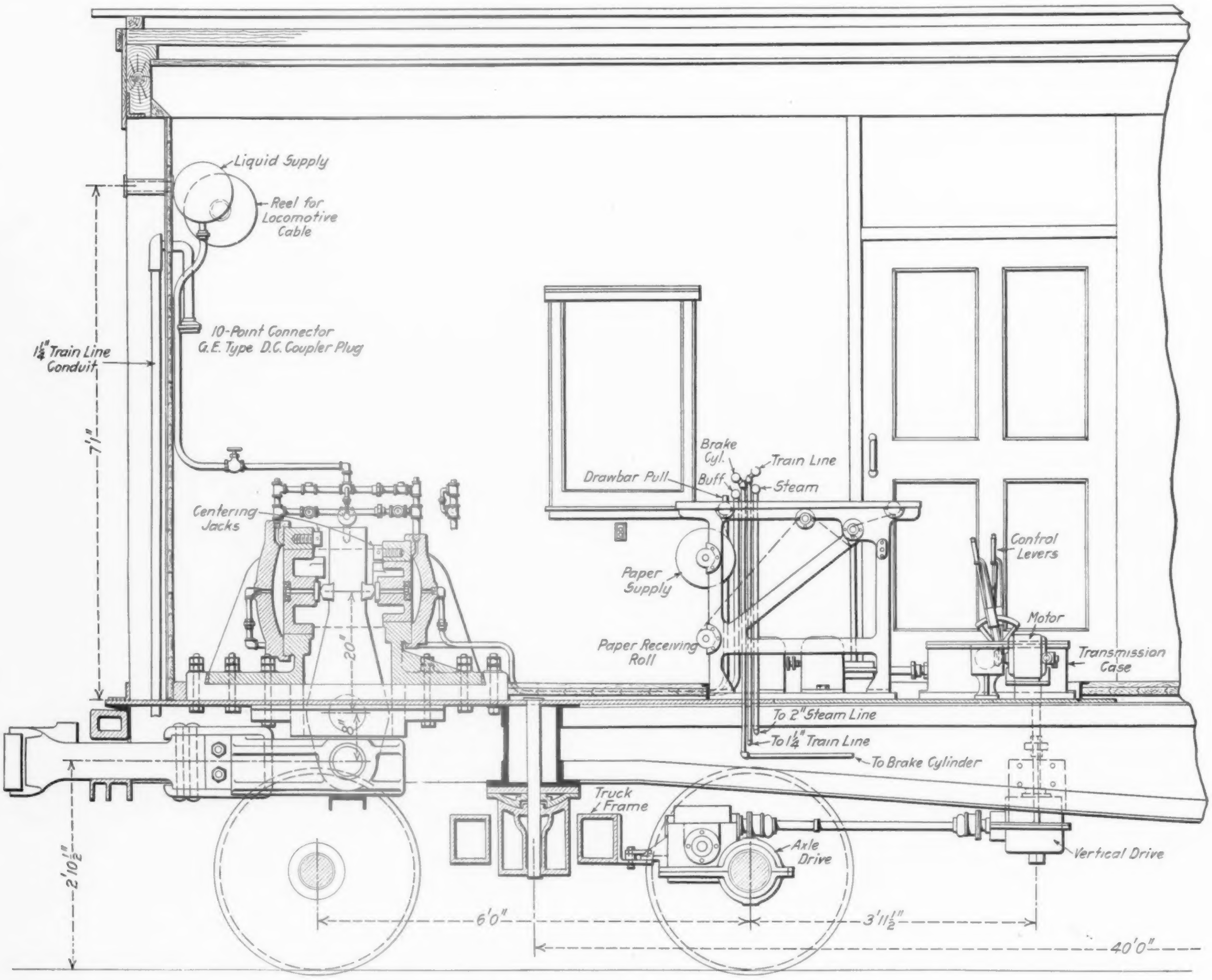
On the end of the transmission case there is provided a shaft rotating in proportion to the car travel on which is mounted a timing device giving a distance contact for each 25, 50 and 100 ft. travel of the car. The truck wheels that are used to drive the mechanism are turned to a definite circumference and are without brakes for the purpose of eliminating the wear due to the brake shoe friction. A wear of ⅜ in. on the radius is permissible, the wheels having 3/16 in. excess radius when new to maintain maximum average accuracy in service.

DYNAMOMETER

The dynamometer itself is of special interest due to the large capacity combined with the exceptionally small space it occupies in the car and the compactness of the whole arrangement. It is a new design of the diaphragm type. The coupler is rigidly connected to the bottom of the dynamometer lever, the connection being about 3 ft. back of the end sill. The dynamometer lever itself is pivoted on a 5¾-in. pin, which bears on six hardened steel pins inserted in the bearings to reduce the friction. The upper end of the dynamometer lever is provided with knife edges, which bear on pistons on either side of the lever for recording the buffing and pulling forces. Both the pistons are suspended on knife edge hangers and float in the cylinders, there being a clearance of 1/64-in. between the pistons and the cylinder walls. The buffing piston has about 160 sq. in. of surface and is designed for 2,000



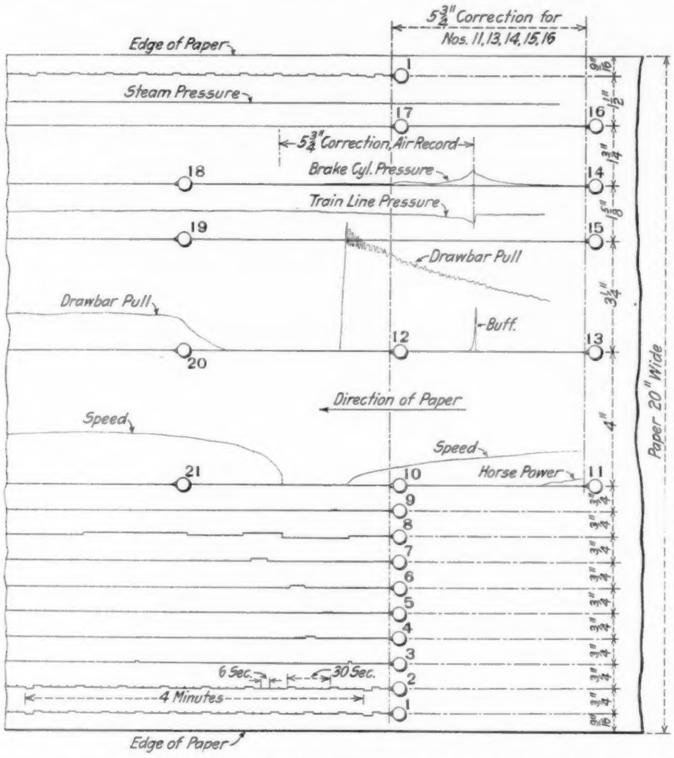
Dynamometer and Drawbar



Arrangement of the Dynamometer and Recording Mechanism

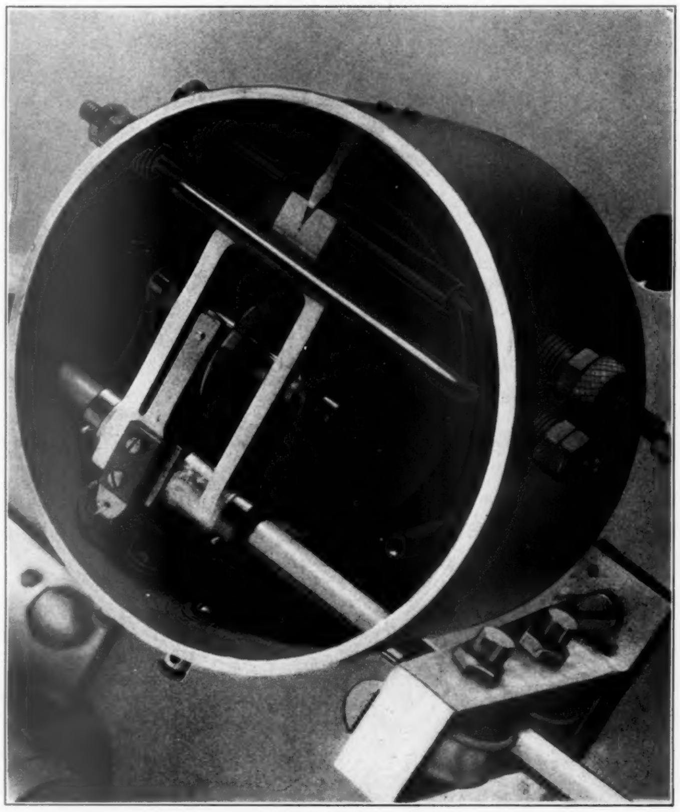
The leverage ratio is 8 to 20, as indicated in the illustration. The coupler has a free up and down movement, but no sideways motion is permitted in this construction. lb. per sq. in., which will give a maximum buffing capacity of 800,000 lb. The piston for recording the pull has 80 sq. in. of surface, which with a working pressure of 1,000 lb. per sq. in.,

gives a maximum pulling force of 200,000 lb. With these high fluid pressures a correspondingly increased sensitiveness is ob-



A Section of the Dynamometer Chart Showing the Arrangement of Recording Pens

tained. Inasmuch as a movement of only .006 in. is required to give the maximum record of drawbar pull, the effect of friction is very slight and the inertia effect of the heavy parts

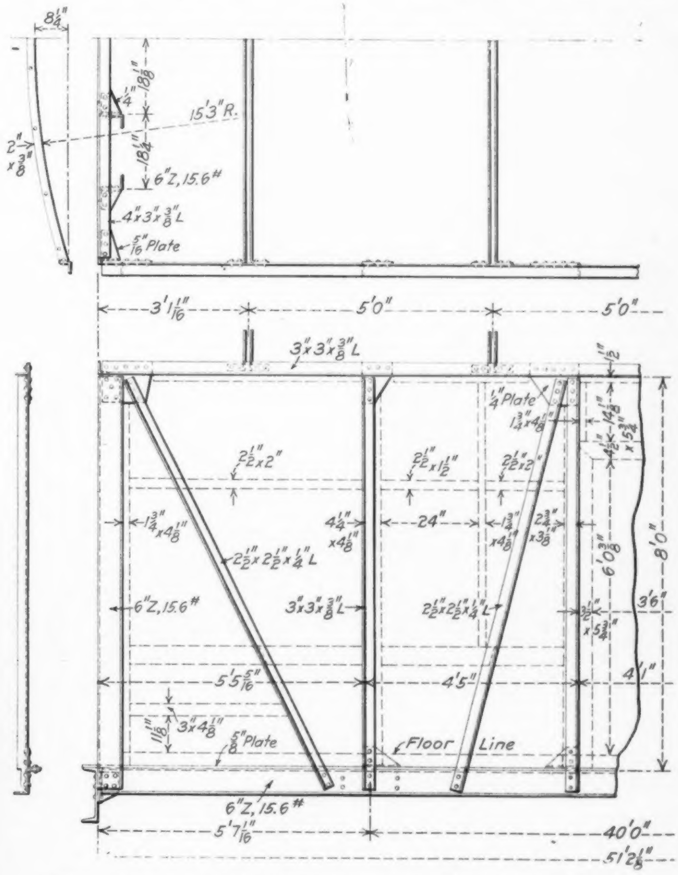


Integrator for Determining the Work Done at the Drawbar

is practically eliminated. A mixture of alcohol and glycerine is used as the pressure medium between the dynamometer and the indicator. Jack screws inserted in the housing of the dynamometer are used to lock the pistons in mid-position when it is desired to replenish the supply of pressure medium in the dynamometer cylinders. The medium is carried in an overhead tank and flows to the cylinders by gravity. The base of the dynamometer itself occupies only 4 ft. 6 in. by 2 ft. 11 in. floor space.

RECORDING TABLE

The recording table is a semi-steel structure with an aluminum top. Provision is made for the operation of 21 pens, which are distributed in three rows. The first row contains four datum pens and the second row contains the pens for registering the distance, integrator records, drawbar pull, speed, throttle position, curves, indicator cards, reverse lever position, coal fired, mile posts and the time. The last row contains the pens for steam pressure, train line pressure, brake cylinder pressure, buffing force and horsepower. A correction of 5¾ in. must be allowed between the second and last rows of pens. The table is designed for

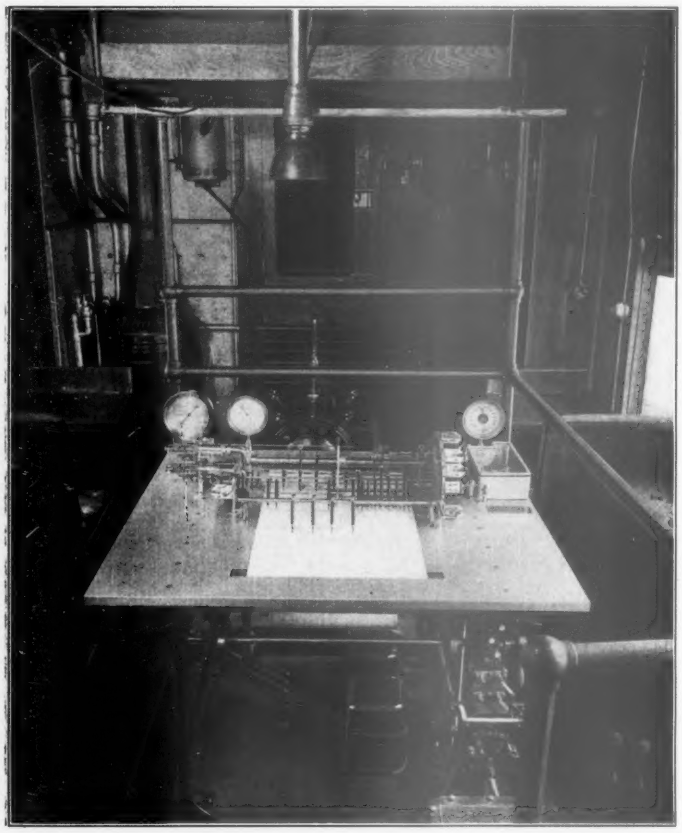


Steel Framing of the Superstructure—Southern Railway Dynamometer Car

paper 24 in. wide, although 20-in. paper is used. On the table is mounted the integrator, which gives a continuous record of the area under the drawbar pull curve. This instrument is of simple construction and is accurate to within a fraction of one per cent. It consists essentially of a flat steel disc with a carefully polished surface, which is revolved at a speed proportional to the paper speed, the ratio being 1½ in. of paper travel per revolution of the disc. A small hardened steel wheel similar to the ordinary type of integrator wheel is carried in a light frame and rests normally at the center of the disc, being moved from its central position by the action of the drawbar pull indicator. Thus, for any distance traveled the number of revolutions of the integrator wheel will be proportional to the product of the paper travel equivalent to the given distance and the average value of the ordinates of the drawbar pull curve. One revolution of the integrator wheel is equivalent to 6 sq. in. of area under the drawbar pull curve and each revolution is recorded on the paper.

The horsepower computer is also located on the top of the

table at the right, just in front of the speed gage. It is a mechanical multiplying machine operating on the triangulation principle, multiplying the ordinate of the drawbar pull curve by a speed value obtained from the Boyer speed recorder. The product, or the horsepower, is recorded on the chart. Ordinary electro-magnets are used for actuating the pens where only offsets are desired. Outside spring Tabor indicators are used for recording the buffing force, train line pressure, brake cylinder pressure and locomotive steam pressure. A special indicator is used to record the drawbar pull, which has a maximum travel of 6 in. Its cylinder has a sectional area of ½ in. and the plunger



Interior of the Southern Railway Dynamometer Car, Dynamometer End

has a travel of [illegible] in. All electrical circuits are controlled by the table operator and are located directly beneath the top of the dynamometer table at the right hand of the operator. Adjacent to the table is the transmission case with its two controlling levers mentioned above, which also may be conveniently reached by the operator. The recording table is equipped with suitable mechancal drives for the accurate driving of the paper.

The electrical circuits that are operated from the locomotive are contained in a cable which runs from the dynamometer car over the tender to the locomotive. This cable contains 10 different circuits. When not in use it is wound on a reel just inside the car. The car is provided with an axle lighting system.

Meaning of "Heavy" Steam Gage or Safety Valve.—In each case the terms are to be used according to the purpose of the appliance. When a steam gage indicates more pressure than it should, it is said to be "heavy," as a short method of imparting information that its indications are higher or "heavier" than the actual pressure. The operation or the adjustment of a safety valve is said to be "heavy" or "too heavy" if the pressure at which it blows is too high or too heavy for its purpose, or if the valve does not blow until the pressure of the boiler is greater than the pressure for which the valve is supposed to be loaded.—*Power*.

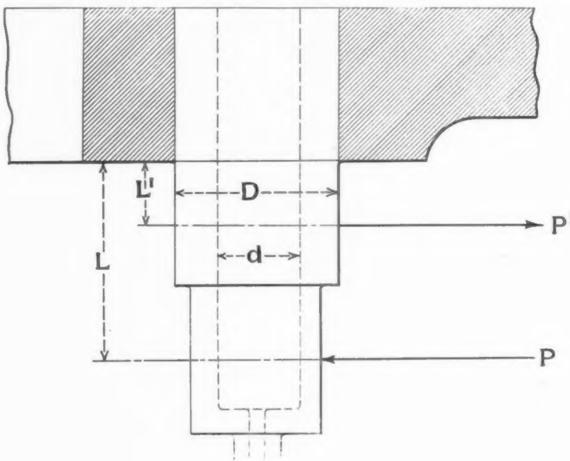
DESIGN OF HOLLOW CRANK PINS

BY C. W. BENICA

With the tendency toward larger and more powerful locomotives the crank pin diameters have assumed proportions that a few years ago would have been suitable for axles. The weight of the crank pin and its portion of the counterbalance have thus been very greatly increased.

Two methods are available to reduce this weight—the use of eccentric main crank pins* whereby the radius of the side rod throw may be reduced without effecting the piston stroke; and the use of hollow crank pins. The former method is unsatisfactory for a number of reasons. The eccentricity of the crank pin cannot be made very great without increasing the diameter of the pin at the face of the hub. But perhaps the most serious objection from a mechanical standpoint is the increased stress put upon the pins and rods, due to the decreased moment arm of the forces acting on the side rods.

The hollow crank pin seems to be the most effective means of reducing the crank pin weight. A possible reduction of from 26 per cent to 30 per cent of the usual weight can be made by



careful use of this method. The required diameters can be found by considering the pin as a beam fixed at one end and loaded at the other and applying the cantilever formula:

$$M = \frac{S\ I}{C} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

in which:

M = the bending moment
S = the allowable fiber stress
I = moment of inertia of a hollow circular section = $\frac{D^4 - d^4}{64}$
C = distance of neutral axis to extremities of section = $\frac{D}{2}$
D = outside diameter of hollow section
d = inside diameter of hollow section

The bending moment should be taken with the engine on the front dead center because the piston pressure is then greatest and the pin receives no support from the side rod. The bending moment can be represented by:

$$M = P \times L,$$

in which:

P = piston load = area of piston × boiler pressure,
L = length of pin from hub face to center line of main rod,

Substituting the values given above for $\frac{I}{C}$ equation (1) becomes

$$P\ L = \frac{\pi}{32}\left(\frac{D^4 - d^4}{D}\right) S \qquad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$D = \frac{(D^4 - d^4)\ \pi\ S}{32\ P\ L} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

At this point it is necessary to assume a definite ratio of ex-

* The use of this pin in British practice was referred to in H. A. F. Campbell's article on "Reciprocating and Revolving Parts," page 442, September, 1915.

ternal to internal diameter. Judgment and practice seem to indicate a ratio of $\frac{D}{d} = 2$ as being about right and this ratio is used in deriving the following formula. Substituting for d its value in terms of D, formula (3) becomes,

$$D = \frac{\left(D^4 - \frac{D^4}{2}\right)\pi S}{32 P L}$$

Using the sub letter m to indicate that the values are for the main crank pin, and reducing, the following formulæ are obtained:

$$D_m = 8\sqrt[3]{\frac{P L}{15 \pi S}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$d_m = \frac{D_m}{2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

These formulæ may be applied to crank pins other than the main by substituting for P and L their moment $P' x L'$, (see illustration), where

$$P^1 = \frac{W d}{3.5 s},$$

in which:

W = the total weight on all drivers obtaining their motion through the crank pin considered; this is to allow for the maximum force on the crank pin; i. e., when the side of the engine is on a dead center and the other side on the quarter;
d = diameter of drivers in inches,
s = stroke in inches,
3.5 = a constant determined by experiment.

Then, using the sub-letter o to indicate crank pins other than main

$$D_o = 8\sqrt[3]{\frac{P^1 L^1}{15 \pi s}} \quad \ldots\ldots\ldots\ldots\ldots (6)$$

$$d = \frac{D_o}{2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Another method of calculating the diameter of a hollow crank pin is to first calculate the diameter of a solid pin and then make a hollow pin of equal strength. In this case any ratio can be applied much easier than in (3). Let

D_s = diameter of a solid pin = $\sqrt[3]{\frac{32 P L}{\pi s}}$,
D_1 = outside diameter of a hollow pin of the same strength,
d_1 = inside diameter of the hollow pin = $\frac{D_1}{2}$,

Then since the two pins are to be of equal strength,

$$D_s^3 = \frac{D_1^4 - d_1^4}{D_1} = D_1^3\left(1 - \frac{d_1^4}{D_1^4}\right) \quad \ldots\ldots\ldots\ldots\ldots (8)$$

Substituting for D_1 the assumed ratio x, and solving for the outside diameter,

$$D_1 = D_s\sqrt[3]{\frac{1}{1 - x^4}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

The radical $\sqrt[3]{\frac{1}{1-x^4}}$ is constant for any given value of x and the values of the two diameters may be expressed by the formulæ

$$D_1 = D_s \times C \quad \ldots\ldots\ldots\ldots\ldots\ldots (10)$$
$$d_1 = D_1 \times x \quad \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Values of C are very readily determined for any value of x. For instance, with a value of $x = \frac{1}{2}$, C has a value of 1.0275 and for $x = \frac{1}{2.25}$, C has a value of 1.013, thus making it very simple to determine the required diameters of a hollow pin when the diameter of the equivalent solid pin is known.

ROAD TESTS OF EXHAUST NOZZLES

BY E. S. BARNUM

Within the last year locomotive exhaust nozzles of special shapes have come in for considerable attention. Just why they have not received more attention in the past it is hard to understand, unless it is because the average motive power officer dismisses the statement that a locomotive is not steaming with a "make her steam" to the roundhouse foreman. "Make her steam" to a roundhouse foreman usually means but one thing, to reduce the size of the nozzle until the locomotive steams.

While test plant data may be available to show that nozzles

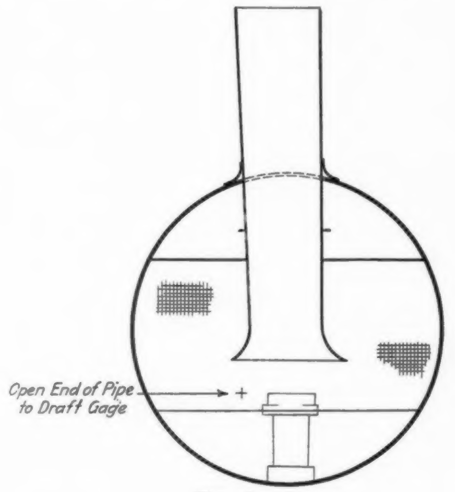


Fig. 1

of special shapes will increase the rate of evaporation and the amount of water evaporated per pound of coal, railroad officers generally are loath to accept such data unless tests made in actual road service indicate the same results. Road tests which would give reliable data as to the coal and water rate, would require the use of a comparatively large corps of trained observers.

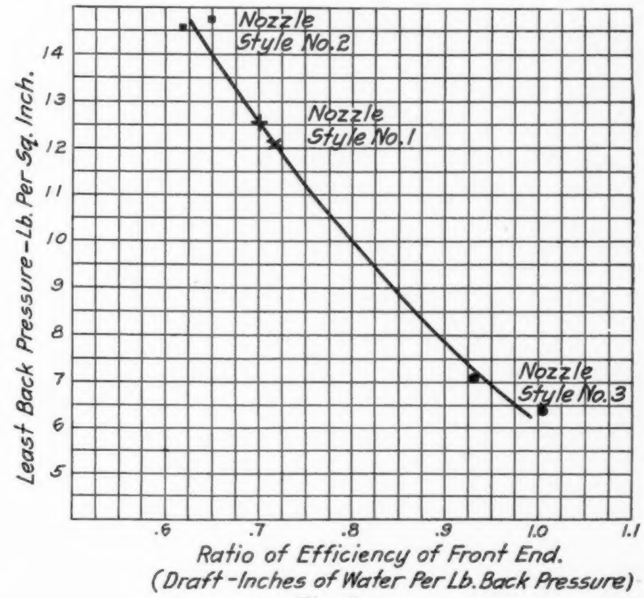


Fig. 2

Possibly this has contributed to the slow development not only of the nozzle but of the whole front end as well. Such exhaustive tests are not necessary, however, to obtain a comparison of the work actually being done by different styles of nozzles.

The exhaust does work in creating draft at the expense of work done in the cylinders. The greater the work done by the exhaust the higher the back pressure. The back pressure can

be measured accurately with indicators and the amount of draft created can be determined with the ordinary draft gage, the open end of which should be located at the height of the nozzle and about 6 in. away, as indicated in Fig. 1. By reducing the results thus secured to draft in inches of water per pound of back pressure, we obtain a ratio which may be considered as an expression of the efficiency of any exhaust nozzle. The data to be secured and the method of comparing the performance of different nozzles is shown in the table, the data there shown being taken from an actual test. The curve in Fig. 2 is obtained by plotting the draft per lb. of back pressure against the least back pressure.

Test Data for Determining Efficiency of Exhaust Nozzles

Nozzle style	Least back pressure A	Draft B	Ratio of efficiency $\frac{B}{A}$
1	12.5	8.75	.7
1	12.05	8.67	.72
2	14.55	9.02	.62
2	14.7	9.55	.65
3	7.1	6.6	.93
3	6.4	6.4	1.0

All of above nozzles have an opening equivalent to the opening of a 5½" round nozzle.

It is a simple matter to secure readings at the same speed, position of reverse lever, throttle and boiler pressure. The thickness of the fire has an appreciable effect on the draft secured in the front end and as it is next to impossible to measure accurately the depth of fire on a locomotive while working, the tests should be conducted with an assigned fireman who is known to do steady, consistent work with a level fire. Before beginning the tests preliminary readings should be taken to determine that the vacuum in the ashpan is not more than .1 to .2 in. of water. If it runs higher than this, additional openings should be made till this figure is reached. Readings of such a small amount are hard to get on the road due to the oscillation of the locomotive. After trying out a number of different methods, the writer finally hit upon the scheme of

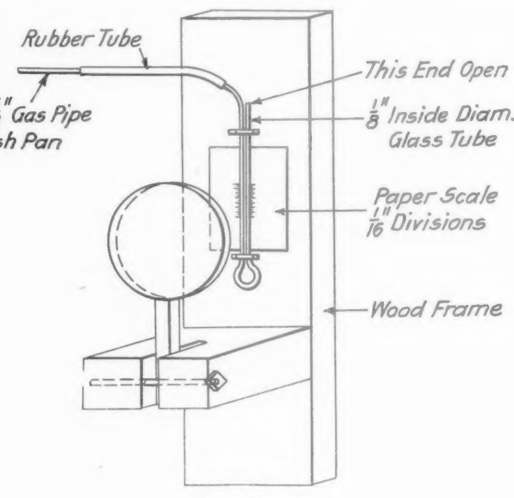


Fig. 3

using a gage of small diameter glass tubing, and making the readings with a magnifying glass as shown in Fig. 3. The capillary action of the water in the small tube seems to have a steadying effect on the column, making it possible to get more accurate readings.

Any test work on nozzles, irrespective of its purpose, would not be complete without data relative to the action of the exhaust in the stack. The nozzle tip acts in much the same way as the throat of a venturi tube, and the exhaust column and stack, or lift pipe, constitute the conical approaches to the throat. A change in either might necessitate a change in either, or both, of the other two, if we are to get the highest efficiency. It is essential that the exhaust elements be in line. This is a shop proposition, and the stack and exhaust column should be lined up before any road work is attempted. To get the maximum draft out of the exhaust it should hit the stack about three or four inches from the top. As shown at *A* in Fig. 5 a stack which is too small would cause the exhaust to hit too far down, while one that is too large would allow the exhaust to pass out without filling it, thereby losing some of the effective vacuum, as shown at *B*.

The plane at which the exhaust is hitting the stack can be

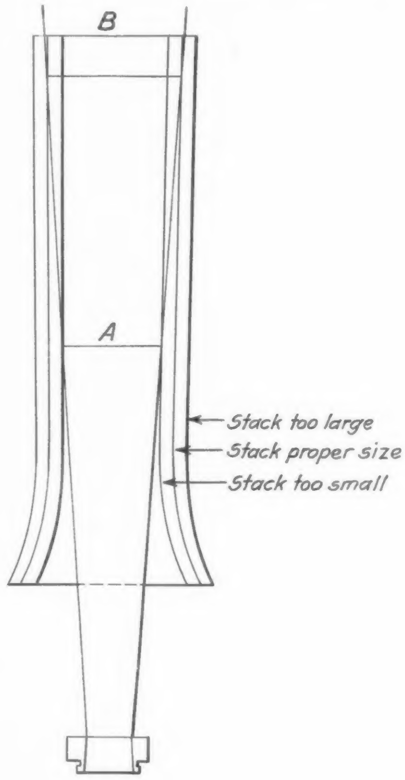


Fig. 4

located with a U-shaped piece of pipe of small diameter having a pipe cap on one end with a ⅛-in. drilled hole, and the other end connected to a mercury filled draft gage by means of a piece of rubber tubing. By moving the pipe up and down the inside of the stack at several different locations the point of neither pressure nor vacuum can be located. Only a few of these readings are necessary for each change in the front end. A few readings of each style of nozzle should be taken across the top of the stack* to show how the pressure is equalized. These readings should be taken parallel, and at right angles to the track, using a run of small sized pipe with a ⅛-in. drilled hole in the center. Suitable hooks, or guides, should be provided around the outside of the stack. Nothing connected with the test apparatus should be permanently located in the stack as it will have an effect on the steaming of the locomotive.

In the last proceedings of the American Railway Master Mechanics' Association, one of the committees reports that a number of roads have experimented with special types of nozzles, and "claim a considerable saving in coal as a result," and that "the subject presents a fertile field for future investigation." The writer knows of a case where a road crew made their locomotive steam by wedging a 14-in. monkey wrench across the top of the stack. They were not correcting the defect but were effecting a cure by means of a "counter-irritant." Such incidents point to the need for a more detailed investigation, not only of the nozzle but of the whole front end.

*For more detailed description of methods employed in determining stack conditions see an article by the same author on page 454 of the September, 1915, issue of the *Railway Age Gazette, Mechanical Edition*.

LOCOMOTIVE WATER AND COAL CONSUMPTION

Methods for Calculating Water and Coal Consumption Under Different Operating Conditions

BY HAROLD A. HUSTON
Rock Island Lines, Chicago, Ill.

Water Consumption.—Water consumption varies greatly with the conditions of operation. The amount of water used per unit of time when a boiler is working to its limit is constant for different speeds if these speeds are above the maximum speed where boiler pressure can be maintained with full cut-off. If these speeds are below the maximum speed where boiler pressure can be maintained with full cut-off, then the water consumption varies directly with the speed. Reference to Fig. 1 will make clear these statements. For example, let us see how Fig. 1 is developed. This figure represents the water and coal consumption for a locomotive, a few of whose dimensions are as follows:

Diameter of drivers	63 in.
Cylinder diameter	24 in.
Cylinder stroke	30 in.
Boiler pressure	200 lb.
Heating surface	3,614 sq. ft.
Volume of each cylinder	7.83 cu. ft.

It is reasonable to expect 11.5 lb. of equivalent evaporation as a maximum for each square foot of heating surface per hour for this locomotive. At this rate, the maximum amount of actual steam generated and used per minute without a drop in the boiler pressure is:

$$\frac{11.5 \times 3614}{1.2 \times 60} = 578 \text{ lb.}$$

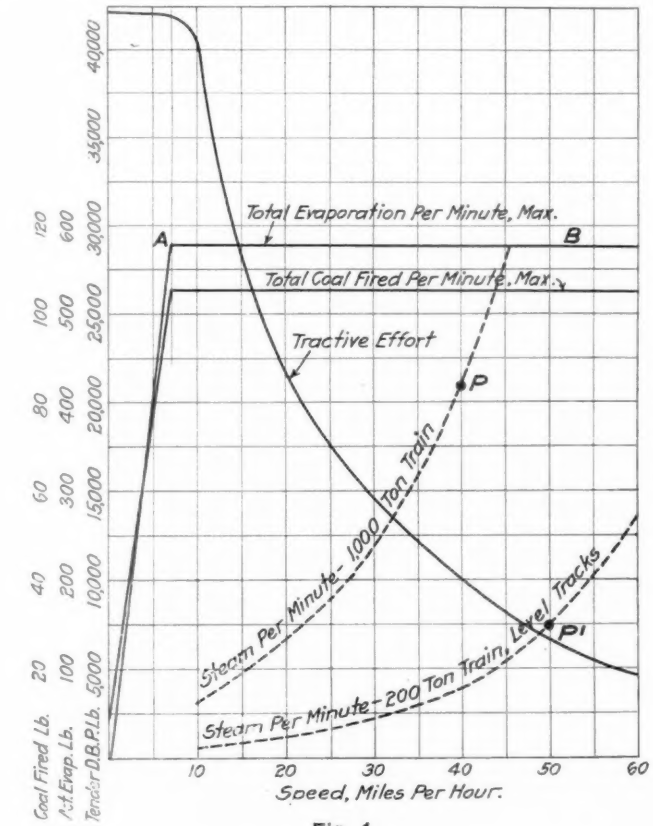


Fig. 1

The temperature of the feed water is taken at 60 deg. F. and the equivalent evaporation is corrected, by dividing by 1.2, to give the actual evaporation at 200 lb. pressure. For one revolution of the drivers, assuming that the valve gear is so designed that a maximum cut-off of 88 per cent is obtained and that the quality of the steam in the cylinders at cut-off is 80 per cent, the steam consumption when the maximum tractive effort is based on cylinder power, is calculated as follows: From steam tables, the weight of one cubic foot of steam in the cylinders at 200×0.95 (or 190 lb.) is 0.447 lb. The weight of one cubic foot of water at a temperature of 384 deg. F., corresponding to 190 lb. steam pressure, is 54.19 lb. By assumption, one pound of the mixture of steam and water contains 0.80 lb. of steam and 0.20 lb. of water, therefore $\frac{0.80}{4.47} + \frac{0.20}{54.19}$ gives a total volume of 1.7907 cu. ft. for one pound of the mixture. The number of pounds of the mixture required for one revolution of the drivers is:

$$\frac{7.83 \times 4 \times .88}{1.7907} = 15.28 \text{ lb.}$$

No allowance is made for clearance, as it is assumed that the pressure due to compression is equal to the initial pressure at cut-off. From the calculations, it is evident that the volume at cut-off represents the quantity of the mixture of steam and water used in one stroke. Now, the maximum train speed at full cut-off (88 per cent) where full boiler pressure can be maintained is:

$$\frac{578}{15.28} = 37.8 \text{ revolutions per minute.}$$

This maximum train speed converted into miles per hour gives 7.09.

At one-half, or at $\frac{1}{x}$ of the maximum speed at full cut-off as at 3.55 m. p. h. or at $\frac{7.09}{x}$ m. p. h., the steam consumption would be one-half, or $\frac{1}{x}$, as great; or, in other words, the steam consumption from zero speed to that speed where the cylinders can develop maximum tractive effort without exhausting the boiler, varies as a straight line, as is shown by the line OA in Fig. 1. For other speeds, it is obvious that the maximum cut-off for a particular speed will require a steam consumption equal to the amount that the boiler can generate without a decrease in boiler pressure. This is represented by the line AB in Fig. 1. For ordinary conditions of operation, it is unusual for a locomotive to work under maximum power conditions for long periods of time; generally about 30 minutes can be taken as a maximum limit of time except in mountainous regions. For this reason, it becomes necessary to develop a process for determining the steam consumption for such periods of average operation.

If the effect of changes in the rate of evaporation and in the quality of the steam in the cylinder at different cut-offs is neglected, and the advantage gained by permitting a given amount of steam to work expansively, as at short cut-offs, is also neglected, it seems reasonable to expect the tractive effort to be a reliable measure of the capacity to which the boiler is worked. Under these assumptions, we may consider that the ratio of the required tender drawbar pull to the available tender drawbar pull for any speed and any train in question, gives the percentage of maximum capacity to which the boiler is worked. Expressed as a fractional ratio, we have:

$$\frac{\text{Required T.D.B.P.}}{\text{Available T.D.B.P.}} = \text{Approximate percentage of maximum capacity to which the boiler is worked.}$$

As shown by Fig. 1, the steam consumption has been based

upon a unit of time, viz., the minute. For the problem in hand, it is convenient to take the time required for the locomotive to exert power on a train from the speed-time curves as shown in Fig. 2. It is obvious that the maximum steam consumption per minute is constant when the boiler is working to its capacity or when the engine is running at its maximum speed and the capacity of the boiler is taxed. At low speeds the engine may be working to a maximum, but the boiler may be working much below its capacity. In such instances where acceleration is taking place, the steam consumption is based on the average speed during that period of acceleration. In other words, if

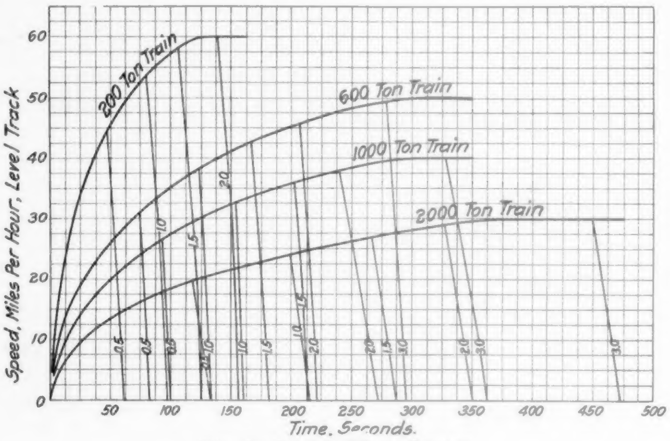


Fig. 2—Speed—Time Curves

S is the value of the steam consumption at the speed V where the boiler is just able to supply the steam at maximum cut-off, and since it is obvious that the steam consumption at zero speed is zero, then the average amount of steam used during acceleration to the speed V is $\frac{S}{2}$.

Accordingly, to find the steam consumption for any locomotive at the head of a train for maximum conditions of operation, first take the steam consumption during the time the locomotive has its maximum tractive effort determined by the cylinders and add to this the steam consumption during the period that the maximum tractive effort is determined by the

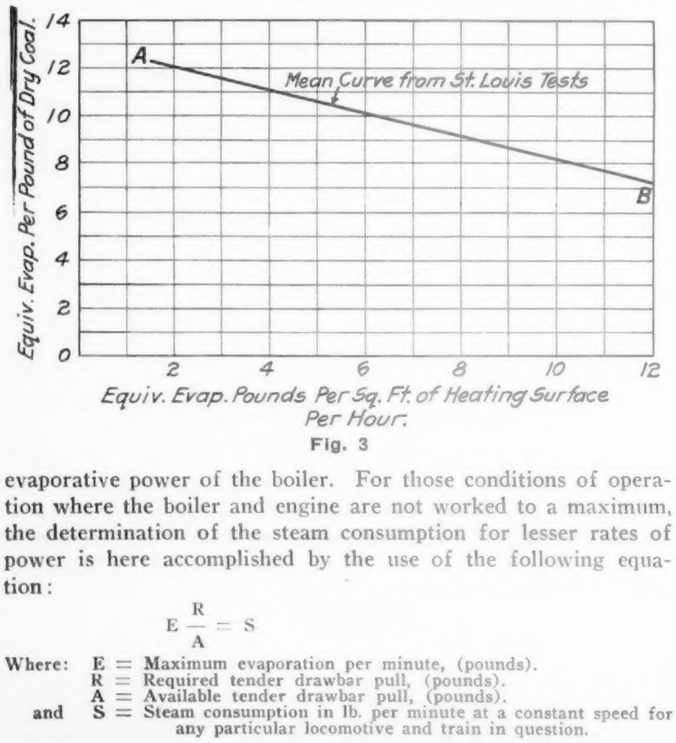


Fig. 3

evaporative power of the boiler. For those conditions of operation where the boiler and engine are not worked to a maximum, the determination of the steam consumption for lesser rates of power is here accomplished by the use of the following equation:

$$E \frac{R}{A} = S$$

Where: E = Maximum evaporation per minute, (pounds).
R = Required tender drawbar pull, (pounds).
A = Available tender drawbar pull, (pounds).
and S = Steam consumption in lb. per minute at a constant speed for any particular locomotive and train in question.

For example, by reference to Table I, which shows in tabular form the accelerations for the locomotive under consideration we find that the 200-ton passenger train and the 1,000-ton freight train can be hauled on level track to speeds which are in excess of the limits assigned by the conditions of the problem. Therefore, to haul these trains on level track at speeds within the limits imposed by the problem, both the engine and boiler are required to work at a lesser power. For instance, since the locomotive is what is termed a "small driver" locomotive, its speed is limited to 60 m. p. h. The required tender drawbar pull for the 200-ton train at a constant speed of 50 m. p. h. is 1,680 lb., as shown in Column 9 of the table. At this speed the locomotive is capable of developing an available tender drawbar pull of 6,740 lb., as shown in Column 3, which necessitates a maximum actual steam consumption of 578 lb. per minute, as has been heretofore determined. Now, the expression for steam consumption at this low power is:

$$578 \times \frac{1,680}{6,740} = 145 \text{ lb. per minute.}$$

This determines the point P' shown in Fig. 1, on the steam consumption curve for the locomotive and the 200-ton train while running at a constant speed of 50 m.p.h. on level tangent track. All other points on this curve are determined in the same manner.

The steam consumption curve for this locomotive and the 1,000-ton freight train for low rates of power is determined by the same method cited above. But with this problem the

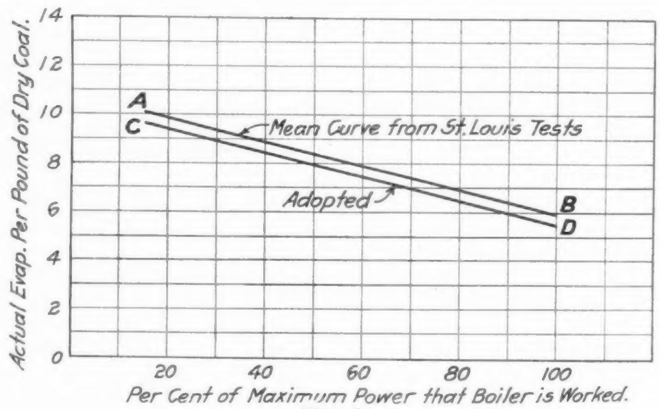


Fig. 4

speed limit imposed is 40 m.p.h., therefore by Table I, Column 12, it is evident that the tender drawbar pull available for acceleration is sufficient to develop a speed of 45 m.p.h. with maximum boiler conditions. The required tender drawbar pull for this 1,000-ton train for a constant speed of 40 m.p.h. is 7,300 lb., as shown in Column 9. At this speed the locomotive is capable of developing an available tender drawbar pull of 10,090 lb., as shown in Column 3, which necessitates a maximum steam consumption of 578 lb. per minute, as has been heretofore determined. Now, the expression for steam consumption at this low power is:

$$578 \times \frac{7,300}{10,090} = 418 \text{ lb. per minute.}$$

This determines the point P shown in Fig. 1, on the steam consumption curve for this locomotive, and the 1,000-ton train while running at a constant speed of 40 m.p.h. on level tangent track. All other points on this curve are determined in the same manner. Thus we have a simple means of determining the water consumption at any power and speed for any locomotive and train.

Coal Consumption.—For estimating the amount of coal consumed under maximum conditions of operation it is necessary to fix the maximum quantity of coal that can be economically fired in a boiler of specified proportions containing a given amount of heating surface. For the case under consideration, the maximum amount of coal consumed per square foot of heating surface is 1.75 lb. And according to the tractive effort formula, a rate of 11.5 lb. of equivalent evaporation may be

expected for maximum conditions. This means that an evaporation of 6.6 lb. from and at 212 deg. per pound of coal, or an actual evaporation of 5.5 lb. per pound of coal is to be expected for maximum conditions of operation. These figures appear rather low when compared with test plant data, but if compared to the results from road tests, it is seen that the figures here presented are representative of actual road conditions.

For lower power conditions, the amount of coal consumed depends on the amount of steam used, although not in a direct proportion. During operation at such rates of power, the amount of work performed per pound of steam is greater than at higher rates of power. Then again the amount of steam generated per pound of coal is greater at low power than at high power. Locomotive fuel consumption as affected by these two combinations of conditions, is not accurately determinate. An attempt at the solution of the problem is made by neglecting the first condition, and by correcting for the second. As in the method outlined for determining water consumption, the ratio of the required tender drawbar pull to the available tender drawbar pull for a locomotive at the head of a certain train when running at a selected constant speed, gives the percentage of maximum power to which the boiler is worked. As stated before, the coal consumption is known for maximum power conditions; it only remains to correct for the law governing the increase in water evaporation per pound of coal for different rates of boiler power.

If we let the rate of evaporation per square foot of heating surface per hour represent the rate of power to which a boiler is worked, then the curve in Fig. 3 represents the variation in the evaporation per pound of coal for different rates of power. The curve is based on a grade of coal equivalent to the coal used in determining the tractive effort of the locomotive in question. As stated before, the maximum rate of equivalent evaporation per square foot of heating surface is 11.5 lb., therefore the curve *AB* shown in Fig. 3 can be plotted to new scales and given the form shown as curve *AB* in Fig. 4. Now, the problem under consideration has shown that at maximum rates of boiler operation, the actual evaporation per pound of coal is 5.5 lb., therefore the point *D* has been taken so that its abscissa equals 100 per cent, and the corresponding ordinate is 5.5, and the curve *CD* has been drawn through the point *D* parallel to *AB*; or, in other words, the curve *CD* is drawn to have the same slope as *AB*. The curve *CD* then represents the actual evaporation per pound of coal for the various rates of power that the boiler is worked.

To get the pounds of coal consumed when the boiler is working under less than maximum power conditions, first determine the percentage of maximum power that the boiler is worked, and then divide the water consumption as previously determined, by the evaporation per pound of coal as given by curve *CD* in Fig. 4.

TABLE I

Speed M.P.H. 1	Available tender Drawbar pull—in lb. 1 per cent up grade 2	Level 3	1 per cent down grade 4	Available drawbar pull per ton of train—in lb. 1 per cent up grade 5	Level 6	1 per cent down grade 7	Resistance per ton of train—lb. 1 per cent up grade 8	Level 9	1 per cent down grade 10	Drawbar pull available for acceleration—lb. per ton 1 per cent up grade 11	Level 12	1 per cent down grade 13
						200 TON TRAIN						
0	....	....	....	....	....	....	....	....	....	....	....	....
5	38430	42110	45790	192.2	210.6	229.0	23.72	3.72	—16.28	168.5	206.9	245.3
10	36805	40485	44165	184.0	202.4	220.8	24.00	4.00	—16.00	160.0	198.4	236.8
15	25680	29360	33040	128.4	146.8	165.2	24.34	4.34	—15.66	103.1	142.5	181.9
20	18390	22070	25750	92.0	110.4	128.8	24.74	4.74	—15.26	67.3	105.7	144.1
25	13980	17660	21340	69.6	88.3	106.7	25.20	5.20	—14.80	44.7	83.1	121.5
30	11000	14680	18360	55.0	73.4	91.8	25.72	5.72	—14.28	29.3	67.7	106.1
35	8320	12000	15680	41.6	60.0	78.4	26.28	6.28	—13.72	15.3	53.7	92.1
40	6410	10090	13770	37.1	50.5	68.9	26.94	6.94	—13.06	5.2	43.6	82.0
45	4550	8230	11910	22.8	41.2	59.6	27.60	7.60	—12.40	....	33.6	72.0
50	3060	6740	10420	15.3	33.7	52.1	28.40	8.40	—11.60	....	25.3	63.7
55	1800	5480	9160	9.0	27.4	45.8	29.28	9.28	—10.72	....	18.1	56.8
60	620	4300	7980	3.1	21.5	39.9	30.10	10.10	—9.90	....	11.4	49.8
						1000 TON TRAIN						
0	....	....	....	....	....	....	....	....	....	....	....	....
5	38430	42110	45790	38.4	42.1	45.8	24.01	4.01	—15.99	14.4	38.1	61.8
10	36805	40485	44165	36.8	40.5	44.2	24.27	4.27	—15.73	12.5	36.2	59.9
15	25680	29360	33040	25.7	29.4	33.0	24.60	4.60	—15.40	1.1	24.8	48.4
20	18390	22070	25750	18.4	22.1	25.8	25.00	5.00	—15.00	....	17.1	40.8
25	13980	17660	21340	14.0	17.7	21.3	25.47	5.47	—14.53	....	12.2	35.8
30	11000	14680	18360	11.0	14.7	18.4	26.00	6.00	—14.00	....	8.7	32.4
35	8320	12000	15680	8.3	12.0	15.7	26.62	6.62	—13.38	....	5.4	29.1
40	6410	10090	13770	6.4	10.1	13.8	27.30	7.30	—12.70	....	2.8	26.5

FUEL ECONOMY*

BY H. C. WOODBRIDGE
Assistant to General Manager, Buffalo, Rochester & Pittsburgh

As matters of particular import to fuel economy, I would suggest boiler and engine design, construction, maintenance and operation, upon which many excellent treatises have been prepared. But to be more specific, let me recommend superheating apparatus, brick arches, combustion chambers, draft regulation, feed water heaters, condensers, re-heaters, stokers; the selection, preparation and storage of fuel, including both powdered and liquid combustibles; valve gears and setting to insure proper steam distribution; the elimination of unnecessary fires, particularly in locomotives not required for service within twenty-four hours; fuel records and accounting; smoke consumers and precipitators; lubrication—which item brings to mind a condition frequently encountered in departmental organization, which is inimical and in some instances disastrous to fuel economy. I refer to the unfortunate practice, prevalent to a large degree in railroad accounting, which removes from the mechanical department ledger all traces of expense for locomotive fuel, and at the same time so conspicuously records the expenses for lubricants on that ledger that the important and direct relation to economy in fuel is lost sight of, and even proper analysis of repair costs is overshadowed and therefore neglected. Study also the requirements necessary to avoid delays to trains, which are responsible for great waste of fuel, and finally, the selection, training and supervision of men, upon which three subdivisions I solicit your indulgence for a moment.

SELECTION OF FIREMEN

One writer says, "Only too often a fireman is chosen for his muscle, low wages and ability to endure high temperatures existing in the fire rooms, and little or no attention is paid his intelligence." In both Germany and Great Britain schools are maintained for the instruction of firemen, and much emphasis is placed on the skill of the individual in handling the fire. They find that it is better to employ a competent man at a rea-

* From a paper presented at the January, 1916, meeting of the Railway Club of Pittsburgh.

sonable wage than it is to employ an incompetent man at a low wage. In this way they avoid the necessity for additional supervision, numerous incidental annoyances, the consumption of a larger quantity of coal and the production of unnecessary black smoke.

In 1907 three hundred firemen had been especially trained by the officers of the Hamburg Society for Prevention of Smoke. A report of this society shows thermal efficiency, with the regular but untrained firemen 66.6 per cent, and thermal efficiency of the same plant with trained firemen 72.7 per cent. These statements, while referring particularly to stationary practice, indicate methods thoroughly applicable to locomotive operation. This is proven by the results of experiments conducted in the laboratory of the Pennsylvania Railroad at Altoona under the direction of Professor Goss. These tests showed a boiler efficiency of 73.2 per cent when the locomotive was fired by experienced men and 59.7 per cent when fired by inexperienced men.

LACK OF SUPERVISION.

We must have efficient supervision, for we all need inspiration, assistance and some discipline lest we become plodders with low aim and little interest; and I would not hazard an estimate of the losses caused by supervision by men whose vision and actions are confined by subnormal limitations of the brain and heart.

To obtain, even approximately, the possible economies, co-operation and interest on the part of every man in the ranks, as well as the officers, is essential. Low grade supervision is responsible for much of the indifference and vicious antagonism encountered in our men; and selfishness, conceit and lack of foresight and education are responsible for most serious delays. Where would our vaunted supremacy be if everyone had carefully obeyed the old adage, "Be not the first by whom the new is tried"? And worse still, imagine the transportation inefficiency from which we would now be suffering had not a few men of foresight and strength fairly jammed the superheater and the stoker and the modern locomotive down the throats of the majority of men in responsible official positions on our railroads. I sat in the Master Mechanics' Association meetings back in 1906-7, when the forceful and eloquent pleading of H. H. Vaughn in favor of superheating our locomotives fell principally on barren ground. The development and application of superheating apparatus has reduced, by at least one-fifth, the fuel consumed in service; and this apparatus, designed primarily to reduce fuel consumption, has simplified the problem of increasing the earning power per old unit. By materially increasing the possible boiler capacity within the limits of size and weight to which our designs must conform, it has, together with the stoker, made possible the modern power plant on wheels, and thus averted more than one crisis.

THE CRYING NEED.

There is another fuel, upon the conservatism or best use of which our progress and perhaps the very existence of our country may depend. I appeal to you to promote development which will insure against waste of this, the most valuable fuel that ever was, or ever will be .nined. I refer to the elements which burn in the mind and heart of the progressive man. There has been a tremendous and cruel waste of this fuel in the superexhaustion enforced on many such men by self-satisfied and narrow men in authority, who have strangled incentive and initiative in their associates until cultures of "What's the use" germs have developed everywhere.

The manager or superintendent who fails to make the most of the corrective and creative power in his associates—which include the supply men—and in his subordinates, has failed to take advantage of his greatest opportunities.

If you encourage initiative in others and aid in the development of their thoughts, you will strike at the heart of the disease which at times cripples our fuel as well as other economy efforts. I commend to you a paragraph from one of the best prayers I ever heard: "O God! Keep us from narrow pride in outgrown ways, blind eyes that will not see the good of change, impatient judgments of the methods and experiments of others."

THE PRINCIPLES OF SMOKE FORMATION

In that part of its report devoted to its investigations of locomotive smoke, the Chicago Association of Commerce Committee of Investigation on Smoke Abatement and Electrification of Railway Terminals, outlined in some detail the principles underlying the formation of smoke. It was pointed out that the factors affecting smoke formation are the combustible, the supporter of combustion (air), and the temperature at which combustion proceeds.

The combustible elements in coal may be grouped into two divisions, namely, volatile matter and fixed carbon, the proportion of these varying greatly in the various kinds of coal. As a supporter of combustion the air may be regarded as being composed of oxygen and nitrogen. Theoretically there must be 2.67 lb. of oxygen, or 11.55 lb. of air, for every pound of carbon. In ordinary furnace operation, however, it is necessary to provide for more than the theoretical amount of air. Regarding the third factor in combustion, namely, the temperature, it may be stated that every combustible has its critical temperature, below which it will not unite with oxygen.

The combustion of bituminous coal proceeds by stages. There is at first a period occurring at comparatively low temperature, about 500 deg. F., of so-called "destructive distillation," in which a disruption in the substance of the fuel takes place, the volatile portion being thrown out and separated from the non-volatile. The second stage of combustion involves the decomposition of the hydro-carbon, the volatile portion, and the burning of its gaseous constituents at a temperature of about 800 deg. F. This stage is a critical one, as regards smoke formation. If too little air is admitted to the furnace, or if the amount admitted is not properly distributed a portion of the carbon in the fuel is carried away unburned and visible smoke results. The third stage of combustion proceeds at a temperature which is nominally about 1,600 deg. F. It is during this stage that the non-volatile portion of the fuel, consisting chiefly of carbon, is burned. The third stage of combustion may easily be made smokeless, but if the supply of air be deficient incomplete combustion and visible smoke may result.

An important aspect of combustion relates to the economical use of fuel, which is a matter that cannot be completely separated from that of smoke prevention. As a result of elaborate tests made in recent years, it has been determined that under certain conditions resulting in apparent smokelessness there may be an escape of unburned combustible gases with a consequent loss of heat units while conditions which may utilize fuel value to a fuller extent result in a slight degree of smokiness. Careful laboratory tests have demonstrated that the amount of heat lost in black smoke is comparatively insignificant, one investigator reporting that under the worst possible conditions of combustion, if the smoke were collected there would be a saving of only 14.7 lb. from a ton of coal, provided all the smoke were burned again.

Advantage of Steam Turbines Using High Vacuum.—In case of a reciprocating engine working condensing, without unduly curtailing the initial volume of steam admitted to the cylinder the number of expansions is limited, and with a high vacuum the walls of the cylinder are alternately exposed to the temperature of the expanding steam and the cooling effect of vacuum, in consequence of which more than about 26 in. of vacuum counteracts the advantage of reduction of the back-pressure by higher vacuum. In the operation of a turbine there is a continuous flow of steam, and the higher the vacuum the greater the kinetic energy developed by the steam.—*Power.*

The Danger of Overdoing Things

The "Old Man" Hands Out Some Good Advice But Falls Down in Making a Personal Application

BY HARVEY DE WITT WOLCOMB

It was a cold, blustering, genuine "rip-snorter" winter's day and railroading at the busy terminal of the X. Y. & Z., at Greenfield, was being handled under the most disagreeable and trying conditions. The failure of any one man, or a slight error of judgment, would have resulted in tying up the place so tight that business would have come to a standstill; therefore, every man was on the jump to help keep things moving. Even the old division master mechanic, Jack Hawthorne, was right on the job every minute, and in the past few days of the cold snap had put in so many long strenuous hours that his usual rough temper was even rougher.

The "Old Man," as every one called him, was one of those old time master mechanics who had learned the business of railroading from long years of bitter experience and it was thoroughly understood that a situation he could not straighten out was beyond the ability of any human being to handle. While he had a good organization and one that could be trusted in difficult conditions, it seemed as if it was the "Old Man's" second nature to have to get out on the ground and take charge of affairs himself and, I believe, that he was never happier than when buried up to his neck in some hard proposition.

While "thawing out his shins" that morning in the round house foreman's office, the message boy handed him a bunch of telegrams, the very first of which made him "snort" and angrily exclaim: "Here is another engine failure charged up against us simply because that fool yardmaster overloaded the 3,900 during this kind of weather. It is all very well to figure out on paper how many cars to leave off a train for every 10 deg. drop in the temperature, but let me tell you that when that 10 deg. drop is helped along with this heavy snow and blustering wind, you had better leave off twice as many cars if you want to keep your trains moving. This *'over'* stuff makes me sick, for all we hear now-a-days is *'over'* something.

"It is the same old story in every department on this railroad for no matter what we try to do, some have to get over-anxious to carry out their part of the program, and it will spoil the entire project unless we stop them in time. Do you know that I have been in the railroad game so long and have seen so many failures caused by this 'over' bug-a-bear that when any one tells me things are moving along without a hitch, I get suspicious that all is not well and I had better get busy before someone overdoes his part. From bitter experience, I have learned that killing an idea or plan is not always the result of unconsciously overdoing some part, but is the result of well laid plans to make the idea appear so ridiculous that it is impossible to obtain the results expected. One of the easiest ways to make people see the folly of some out-landish order is to carry it out to the extremes, for there can be no come-back as long as you are obeying orders, yet the weak points will be brought to light in such a manner that changes will soon be in order.

Penny Wise, Pound Foolish.

"When we first took up the economy idea on this railroad, I could see that our general manager was 'over' economizing and that we would have to pay for some costly experiences unless he would listen to the counsel of his subordinates. We had been working under the economy rule for a short time and I could see that it was on a fair way to be so badly overdone that it wouldn't last much longer, when the general manager had me up to headquarters for a conference on some other matters.

"After we finished our business, the talk switched over to economy, and I tried to counsel with the G. M., but he would have none of it. He got so interested in his argument, that in order to prove his point with actual figures, he reached over to the waste paper basket and picked out an old envelope on which to do his figuring. I believe to this day he thought by using this old envelope as scratch paper he would impress on me how far he, the general manager, was practising economy. Well, say; that was the move to fit my argument, and I shot it into him for all I was worth. I showed him that at his salary, the minute he lost in picking up and straightening out that old envelope, represented more actual money value to the company than the cost of a good sized scratch pad.

"I told him that story of the ambitious shipping clerk in a large concern who was anxious for promotion, and in order to get the notice of his employers neglected his own work to go down in the shipping room and knock nails out of old boxes so that they could be used over again. He figured that his employers would see how he was economizing for them and they would reward his efforts with promotion. His efforts were noticed, but not in the way he had planned on. It was proven that even for a $35 clerk to reclaim nails was a loss to the company and that new nails could be purchased for less that his wages would come to, so the ambitious clerk was promoted out of the back door and a new man put on his job.

"I told 'the boss' that just the other day I had read in the newspapers that our post office department had gone out of its way to commend thrifty post-masters and their assistants who had utilized their valuable time in tying together, for use a second time, pieces of string received around incoming mail. On paper this means a saving of thousands of dollars a year, but it can be carried too far, for post-masters and clerks who can afford to devote any considerable part of their time to tying together the short pieces of discarded twine are probably getting more salary than the twine is worth. It didn't take many arguments like these to bring the G. M. around to my point of view and the result is that he has seen his folly in shoving the economy idea too far, and to-day we have one of the best economy systems in the country.

Hobbies Are Costly

"As I look back over my career, I can see now where this company has lost a lot of money by over enthusiasm of its employees. One case I remember very well, for I guess I was to blame for it. There had just been a new president appointed and we were tipped off in the shop that he was on his way to make an inspection of the shop and that he was a great man for neatness around the shops. I was given charge of cleaning up the place. We had several big pits where we used to keep our pipes, so I dumped every last thing off the shop floor into these pits. What we couldn't get into the pits, I had buried outside the shop. Well after that inspection trip we couldn't find half our material and what we did find was broken or bent out of shape, so that cleanup was overdone to a queen's taste and resulted in a costly experience to the company.

"On the other hand, some one in authority may have a hobby that he honestly believes is of a great benefit to the company; if it is studied from all sides, however, it may be found unnecessary. We once had a master mechanic who was a great 'sticker' on having all tools for machines in nice racks at the different machines. Not only tool racks, but he had nice lockers for the men installed at each machine, for he claimed that a man could waste a lot of time and money by leaving his machine

to go to his locker. Well, the idea was overdone by building a lot of costly racks and lockers at each machine.

"The next master mechanic that we had had a hobby just the other way, for he claimed that all tools should be kept in the tool room and that all the lockers at the machines were in the way of the workmen and should be in a regular locker room. The result was that the matter was again overdone by taking every last tool away from the machines and placing them in the tool room, so that to some extent, the regular shop work was retarded by the men having to run to the tool room so often.

"Some fellows are like an alarm clock, for if you start them going they never get run down till they have lost all their spring. Take my roundhouse foreman, for instance. One day I told him his house was badly littered up and he ought to get busy and clean house. He got busy and over-did the job by throwing out every block and bar about the place, and now when a man wants a block or a bar he has to spend a long time to find it. We all know the importance of this kind of material when it is kept in the proper place, but it certainly makes a roundhouse look untidy when it is scattered all about.

"If our fore-sight was as good as our hind-sight we would never overdo a thing. Some fellows never seem able to see far enough ahead to realize that they are getting in trouble. When I was general foreman in this shop, I had a young mechanic working under me that was extra good. I took quite a liking to this young man and started in to coach him for a foremanship. My master mechanic told me to go slow and to be careful, but I thought I knew the young fellow better than he did, so when the chance came I appointed him to the position as erecting shop foreman. Well, do you know that that young man was a rank failure as a foreman, for being a good fast mechanic himself he thought that every one of the workmen ought to be able to do as much as he would himself.

Danger of Overdoing.

"When I think of some of the deals that I have helped ruin by simply overdoing my duty, I feel ashamed of myself. When the company first tried out the efficiency system in this shop, we foremen didn't quite understand the workings of the system and decided that it would be to our advantage to knock it out. We put our heads together and agreed to overdo the matter to such an extent that the company would soon get sick of its bargain and drop it. You know that the success of efficiency is in the establishing of accurate records, so we started in to keep records. The job of keeping records soon got to be so enormous that we had more clerks employed than we had first class mechanics. About every 10 men had a clerk and the efficiency experts were so numerous that it seemed as if we didn't have any men at all that were really working. Well, the result was that our first attempt to establish an efficiency system was a flat failure and, as we predicted, it didn't last long.

"However, with all of the failures that I have been telling you about, you can find the same results in every day life and you don't have to limit yourself to railroad work. All things considered, I believe there are less failures in railroad work, caused by overdoing, than in the business world. Pick up a newspaper and you will read where some great athlete has failed at the final or supreme test and the reason given is that he was overtrained. Business failures occur and you can trace the trouble back to some part that was overdone, while in our railroad work it doesn't take long to find out the fellows that overdo their part before much damage occurs.

"We railroaders protect ourselves when we find some department that is 'putting it over' on us. Now this engine failure of the 3900 was the direct cause of too many cars in this kind of weather, and, believe me, I am going to put it up to the management to either have our present yardmaster use a little common sense or else put in a man that will. I don't want to see a man get the job that is just the reverse of our over-ambitious yardmaster and be too cautious, for sometimes too much caution will do as much harm as overdoing. When we find a mechanic that is overcautious we generally find he is so slow that he doesn't accomplish anything. I can stand a mistake once in a while better than I can stand a man that doesn't do enough work to keep warm. Whatever you do, don't overdo your strength and ruin your health, for one man cannot do it all in one day.

The "Old Man" had gotten so interested in his talk that he had forgotten the stress of business and had concluded the longest talk that any of his men had ever heard him make. It was a well known fact that he preached the folly of overdoing anything, and it was one of his greatest hobbies to always caution his men to learn when enough is enough. Some of the men remarked that the "Old Man" was one of those fortunate fellows who apparently had "the eighth sense" so well developed that he always knew when "enough was enough."

The cold snap didn't let up any during the day and as business was very brisk, every one was dead tired when night came and it was time for the night force to be on duty.

The "Old Man" had kept plugging all day and if he was tired, he never let on. He seemed to be the busiest man around the plant, in fact he didn't go home to supper, but kept right on the job so as to be sure that everything was in shape to get through the night without tying-up the place.

About 11 o'clock he staggered into the roundhouse foreman's office and before assistance could reach him, sank to the floor, unconscious. First aid methods were given him and the company's doctor was sent for in a hurry. Every man around the plant loved the "Old Man," for although he had a rough manner and was very touchy, every one knew that he was true as steel and quite a crowd gathered about the office.

The doctor soon arrived and after a hasty examination remarked that it was nothing serious, but was simply a case of overdoing. It seemed as if the doctor spoke with a touch of irony, when he continued that men today didn't seem to realize when enough was enough and the people couldn't see "the other side" of things till they had overtaxed themselves till failure overtook them.

THE QUESTION OF PROMOTION

BY F. A. WHITAKER

You hear a lot nowadays about efficiency. If I am one of the rank and file, why should I go out of my way to gain knowledge which at the time does not do me any good financially? Because by so doing I gain more knowledge; knowledge is power and more power means more money. The majority of railroads nowadays promote their own men, but do they always promote men on account of their efficiency? There is a saying: "It isn't what a man knows, it is *who* he knows that counts."

On the other hand, does promotion mean more money? Sometimes it does, sometimes it does not. Take a machinist, engineer or conductor. When these men are promoted to official positions, in the majority of cases it means anywhere from $10 to $20 a month less. Of course in the long run if they make good they will have a chance at the bigger jobs that pay the money.

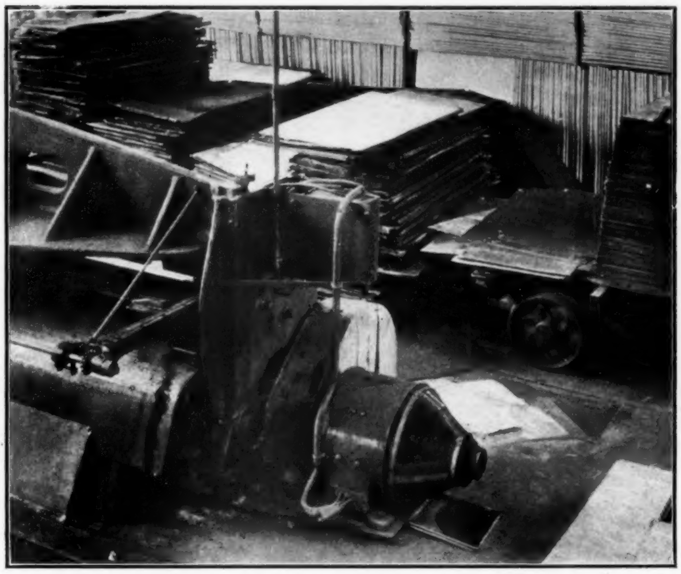
There is also another side to this question. Take, for instance, some of the outside jobs where it is hard to keep a man on account of location and conditions. When a man holding one of these jobs is suggested for promotion, the remark is often made: "He is the only man we have been able to get that has been able to hold down that job; we had better keep him there." As a result the good job goes to another man with perhaps half the efficiency and the more efficient man stays on the old job at the low salary. By the time the outside man has been passed by a few times he gets discouraged and looks for another job on another railroad, where 10 to 1 he starts all over again. If he had stayed with his tools, his engine or his caboose in the first place and had passed up the outside job he would have been making $10 or $20 dollars a month more. After all, efficiency is no good to a man unless he benefits by more money. Some people take into consideration the titles that go with the jobs, but titles do not pay grocery bills.

CAR DEPARTMENT

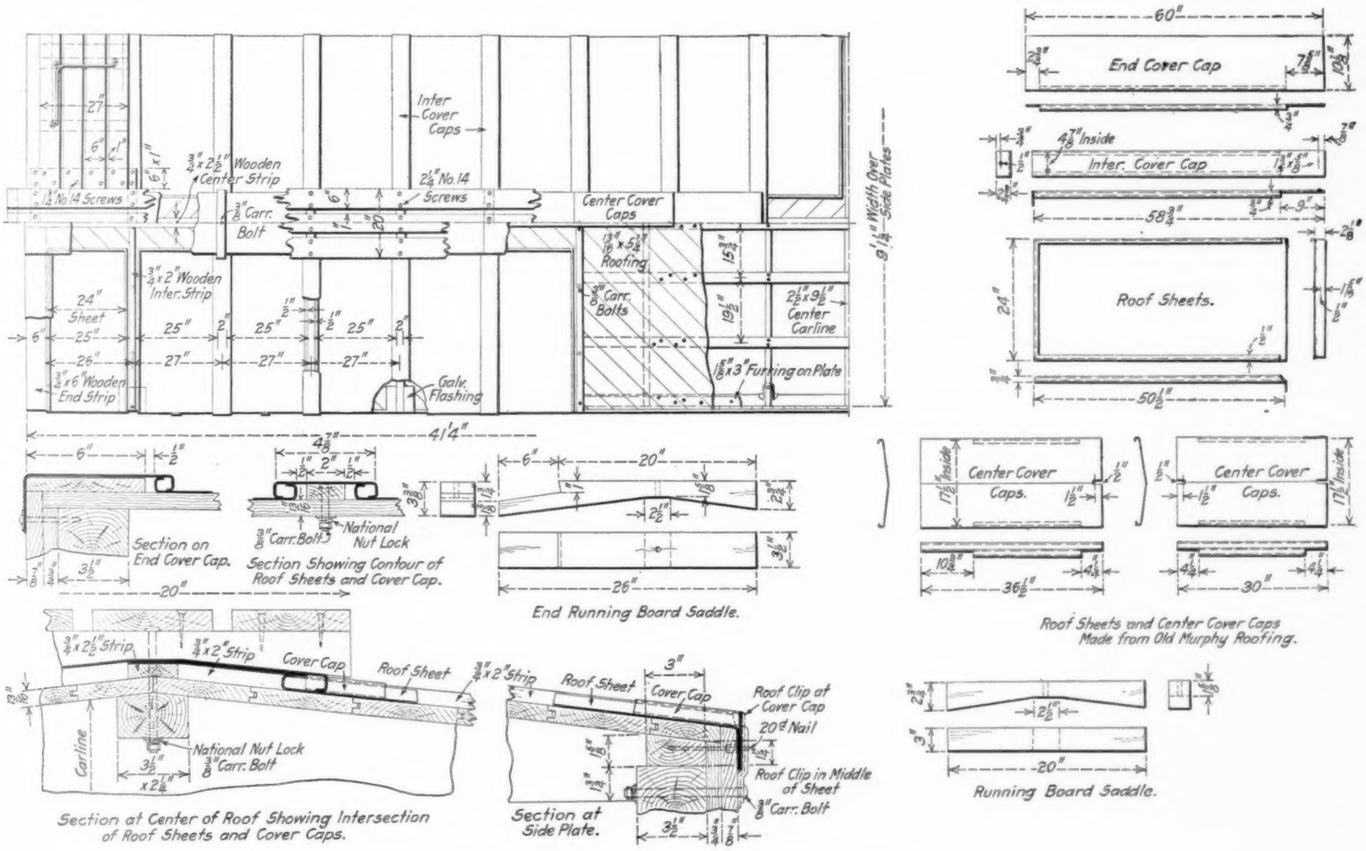
STEEL ROOF FOR BOX CARS

For the purpose of utilizing the good portion of the steel sheets taken from the roof of destroyed cars, William Queenan, assistant superintendent of shops, and Charles Murphy, tinshop foreman, of the Chicago, Burlington & Quincy at Aurora, Ill., have devised a new steel roof. This roof is simple in construction, easy to make, entirely flexible and waterproof. It consists of but five parts: the roof sheets, transverse and center cover caps, eave flashings and the roof clips. The roof sheets are 24 in. by 50½ in. They are crimped on three edges to a U-shape, and flanged on the fourth to pass over the roof at the eaves. The intermediate or transverse cover caps are 4⅞ in. wide by 58¾ in. long. The long edges are crimped and have a free fit in the roof sheets. One end is flanged to pass over the eaves and the other is provided with an elongated hole through which is passed the ⅜-in. carriage bolt which fastens the running board saddle to the ridge pole. The center cover caps are 17½ in. wide and 30 in. long. They are crowned at the center and crimped for part of the way on the long edges. This crimping engages with the crimping on the roof sheets. Each end of the center cover cap is provided with slots 1½ in. long, through which pass the running board saddle bolts. As shown in the drawings, the end pieces of both the transverse and center cover caps are of special construction, being flanged over the edge of the roof and held by clips. Clips are also applied to the middle of each roof sheet, at the eaves.

This roof has many desirable features; it will permit of a large amount of wearing of the car without straining the sheets nor opening up holes for water to leak through. There are no sharp corners nor crevices to collect dirt and hold moisture. Air can circulate freely to all parts of the sheets, thus keeping them in a dry condition. It is an economical roof to make and maintain. The sizes of the roof sheets and center cover caps are so chosen that old roof sheets may be cut down, recrimped and used. It is necessary, however, to make the transverse



Shop Where Old Roof Sheets are Reworked



Steel Box Car Roof; Chicago, Burlington & Quincy

cover caps of new material. The photograph shows the interior of the shop where the old roof sheets are recut to proper dimensions.

STEEL PASSENGER AND FREIGHT CARS

Some of the more important problems in connection with the design and operation of steel cars are touched on in the committee report on rails and equipment, which was made at the twenty-seventh annual convention of the National Association of Railroad Commissioners. The chairman of the committee is Interstate Commerce Commissioner C. C. McChord. The other members of the committee are E. J. Bean of the Missouri Commission, Frank R. Devlin of California, Everett E. Stone of Massachusetts, Paul B. Trammell of Georgia, and William R. Warner of Vermont. That part of the report referring to steel cars is as follows:

The construction of new passenger coaches is now practically confined to steel construction. Several years have elapsed since other than an occasional wooden coach has been built. The number of steel underframe cars has increased by the conversion of wooden cars. The trend in construction is toward a design which possesses sufficient strength in the sills and the lower parts of the body to resist the shocks which may be expected in cases of derailment and collisions. Strength in the sides and roof is also required in cases when the cars are overturned. Types of construction are being presented, in which trussed members are introduced into the sides to furnish the necessary strength and effect some decrease in weight over those types in which the strength is located chiefly in the sills or underframe. The ends should have sufficient strength to prevent shearing of the sides of the car, in resisting telescoping. It has been pointed out that opportunity is presented to introduce some shock absorbing feature in the construction of the vestibule, to relieve the body of shocks of collision in some degree.

The securing of the seats to the flooring is an important matter. The retardation of the speed of a train in collision and its effects on the passengers may be considered, independent of impact of the passengers with objects within the car. In order to avoid such cases of impact, the interior parts of the coach must be firmly attached to the sides or flooring and all bunching of the seats prevented. Thomas E. Brown, consulting engineer, in a communication which was quoted in the report of last year, expressed the belief that passengers, under the assumed conditions of the case as described to him, could endure, without serious injury, retardations as great as the cars themselves would successfully withstand. Mr. Brown mentioned his having personally experienced a retardation of 75 feet per second, without injury, and not much discomfort.

Provided coach construction reaches that stage in which the retardation of speed of the train is not attended with the destruction of the body of the coach and is brought to rest with the interior fittings practically intact, then interest centers on the effect of such retardation on the physical condition of the passengers. During the past year an example was presented in which the retardation reached a very high limit. The steel car which sustained this sudden arrest of speed passed through it without material injury. From a speed of 56 miles an hour, the car came to rest in about three car lengths. There were no cases of personal injury reported, which seemed to have been influenced by reason of this sudden arrest of speed. Examples of high rates of retardation, affording opportunity for acquiring such data, are not numerous, but this case furnished an instance in which the views expressed by Mr. Brown were confirmed.

Injury has been received by steel cars in which local crushing of one end was endured without injury to the opposite end of the car. Gusset plates or other means adopted to give shearing resistance above the floor line, anti-climbers and roof strength, with adequate security of the seats to the flooring, make provision for contingencies which might be expected to arise at a derailment or collision. Passengers in a sitting posture, with some open space in front of them, would be expected to receive injury in colliding with objects within the car, which is a different phase of the problem to that of retardation alone.

Rigidity of form usually accompanies strength in constructive work, and steel cars present greater rigidity than those of wood. The inherent properties of the two materials, steel and wood, constitute an initial difference, while the connections of the parts differ so radically that a further element of rigidity enters into the fabrication of a steel over a wooden car. This rigidity of form makes it desirable to provide flexibility in the running gear. The weight of the car should be distributed as uniformly as possible on the different wheels, and diagonal corners not at times take an undue share of the load.

Concerning the durability of the structural parts of a steel cars on which its strength depends, data are not yet available. In the case of freight cars, durability of the body is largely insured by protecting exposed plates against rust. Thin sheet metal sides are soon destroyed by oxidation if unprotected by paint.

Cars which are rendered unserviceable from local injuries present examples in which the damage has been in part received in the yard. Tests were made by Prof. L. E. Endsley on the impact between freight cars in switching service, the resutls of which were reported to the Master Car Builders' Association at its last convention. The method employed was to ascertain the acceleration of a car, one of a string standing stationary on a slightly descending grade, the end car being struck by another car which was in motion.

The acceleration of the car which was struck was determined by means of a chronograph. In the tests, 55-ton and 90-ton cars, both light and loaded, were used, speeds at the time of impact ranging from .92 to 6.02 miles per hour. The results showed that the car weighing 48,000 lb., when struck by the moving car at a speed of .92 miles per hour, was affected by a maximum pressure of 12,600 lb., which rose to 158,500 lb., when struck by the moving car at a velocity of 5.54 miles per hour.

With a loaded car weighing 143,300 lb., struck by the moving car at 1.87 miles per hour, the force developed was 119,100 lb., which rose to 640,000 lb. when the moving car had a velocity of 4.76 miles per hour.

There was a loss of kinetic energy amounting to 70,000 foot-pounds in one test, concerning which Prof. Endsley remarks: "This can only be accounted for by the destruction of some part of the car."

It was further shown that the stationary car when struck had moved less than one inch at the time the maximum force acted on it.

This fact led to a further remark by Prof. Endsley, that since "this force occurred before car B (the car struck) had moved one inch, the damage to the end of the car would be just as great if only one car were standing, as if a dozen were backing it up, provided there was at least one inch slack between the first and second cars of the standing ones."

The forces of impact shown in these tests were certainly great, and their ability for causing destructiveness will be recognized. In the light of these tests, the life and durability of cars will be materially affected by the stresses to which they are exposed in switching service, which virtually consists of a succession of shocks by impact of varying degrees of severity.

HARDNESS OF WATER.—The designation "hard" is a general term, having specific meaning according to the particular use made of the water. For that reason hardness is generally stated in degrees, and the allowable degree for any given use is specified. According to Clark's standard, a degree of hardness consists of the presence of one grain of calcium carbonate, or its equivalent of another calcium or magnesium salt, per "imperial" gallon of 70,000 grains of water. The American standard is one grain per United States gallon of 58,381 grains of water, and for boiler use water is considered hard if it contains more than 8 grains of the salts to a gallon.—*Power.*

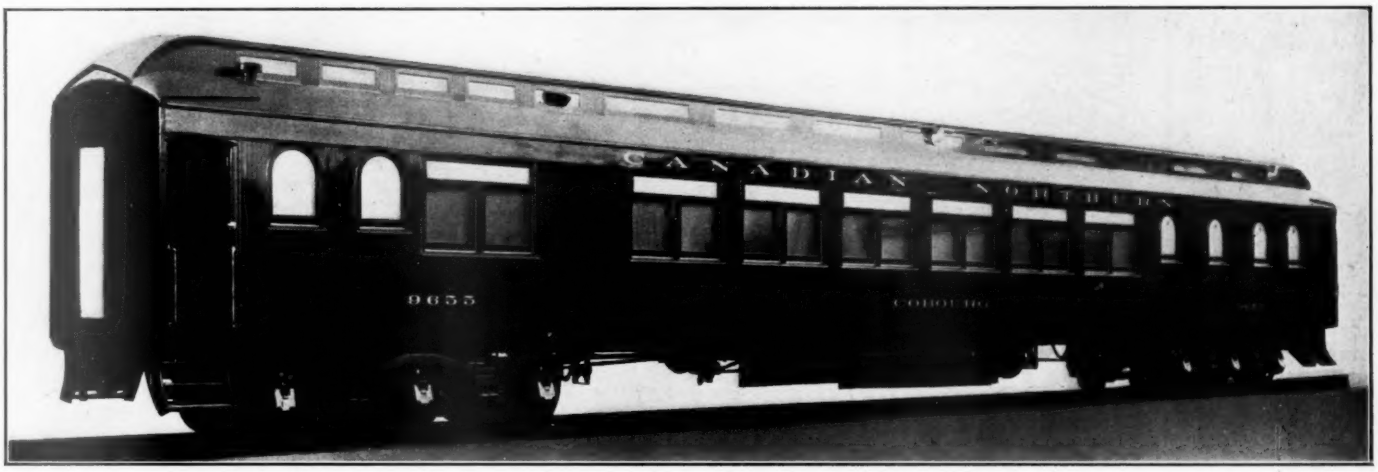
Canadian Northern Passenger Cars

Cars Have Steel Underframe and Body Frame With Wood Finish; For Transcontinental Service

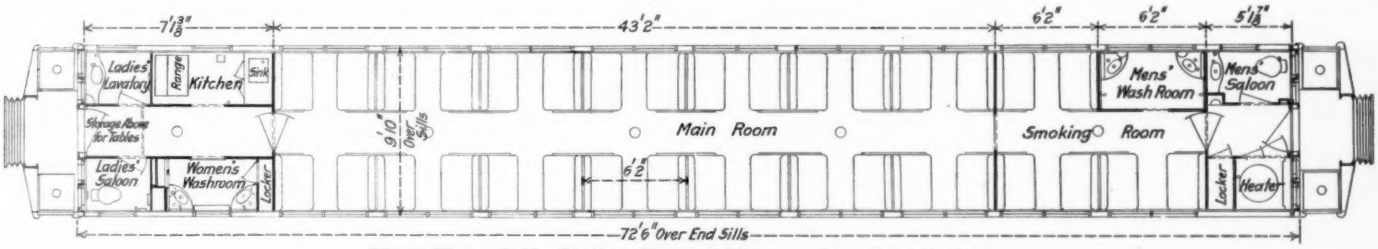
The Canadian Northern during the past few months has placed a lot of 78 new passenger cars in transcontinental service, the equipment being divided into the following classes: 16 coaches, 15 baggage cars, five postal cars, seven dining cars, 11 standard sleepers, nine compartment and observation-compartment sleepers, seven tourist sleepers and eight colonist cars. The cars were built by the Canadian Car & Foundry Company at its Amherst, N. S., and Turcot (Montreal) works, the National Steel Car Company, Hamilton, Ont., the Crossen Car Company, Cobourg, Ont., and the Preston Car & Coach Company, Preston, Ont.

All of the classes are of a similar type of construction, having steel underframes and body frames with wood interior and exterior finish. The cars are all 72 ft. 6 in. long over the body end frames, have a width over the sheathing of 10 ft., and are all provided with six-wheel steel frame trucks. The light weight of the equipment is as follows: postal cars, 137,400 lb.; baggage cars, 131,000 lb.; day coaches, 140,000 lb.; 18-section colonist sleepers, 147,100 lb.; 14-section tourist sleepers, 153,000 lb.; 12-section drawing room sleepers, 154,000 lb.; observation-buffet-compartment sleeper, 155,000 lb., and the 8-section state-room, drawing room sleepers, 155,000 lb. The coaches have a seating capacity of 84 for the second-class and 78 for the first-class and the observation room of the observation sleepers will seat 25 persons.

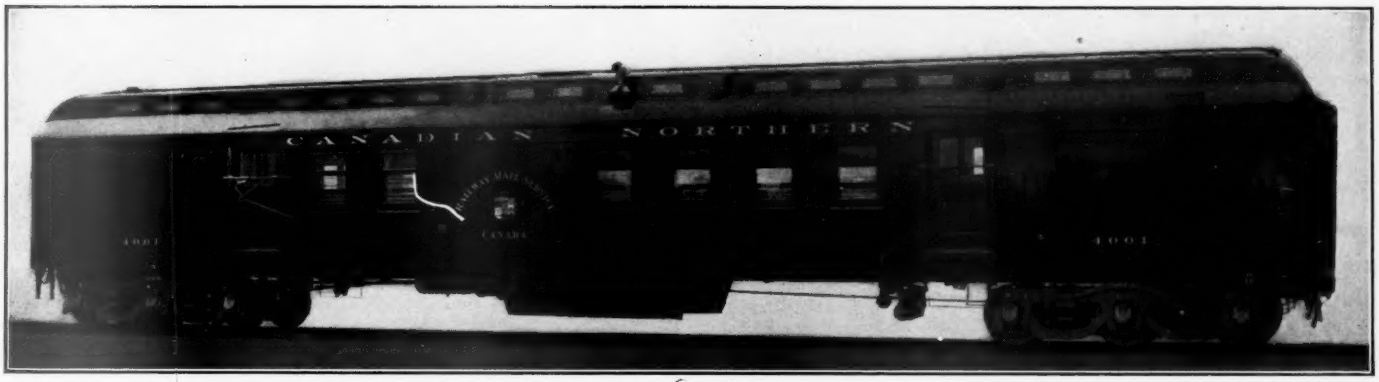
The selection of the composite type of construction is due partly to climatic conditions and partly to the prevailing shop conditions and equipment, which are favorable to the maintenance of cars of this construction. The winter conditions under which the Canadian Northern operates are especially severe. Extremely low temperatures accompanied by high winds are



Canadian Northern Standard 12—Section Stateroom Sleeper



Floor Plan of 14—Section Tourist Sleeper—Canadian Northern

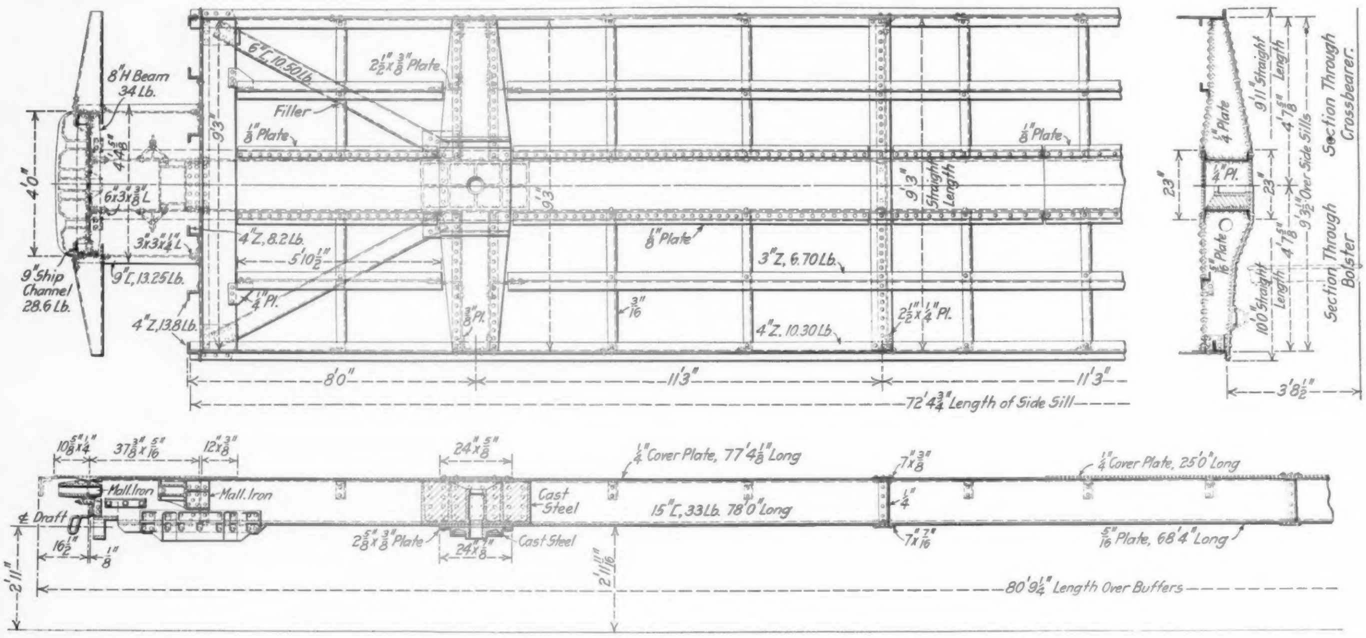


Canadian Northern Postal Car

often encountered on parts of the line, making a construction possessing the highest heat insulating properties very desirable. This consideration makes desirable the use of wood for interior and exterior finish.

The skylight does not project more than 3 in. above the roof of the car at its highest point.

The following is a description of the details of construction of the dining cars. These cars include some features not com-



Steel Underframe; Canadian Northern Dining Cars

A feature of especial interest in the postal cars is a skylight which is placed in the roof of the upper deck. This considerably improves the lighting of the interior under daylight conditions. An opening 2 ft. 9 in. wide by 2 ft. long is provided in the roof of the car. This is fitted with a light metal casing and is closed with two panels of ⅜-in. rough-wired glass. The glass rests in a

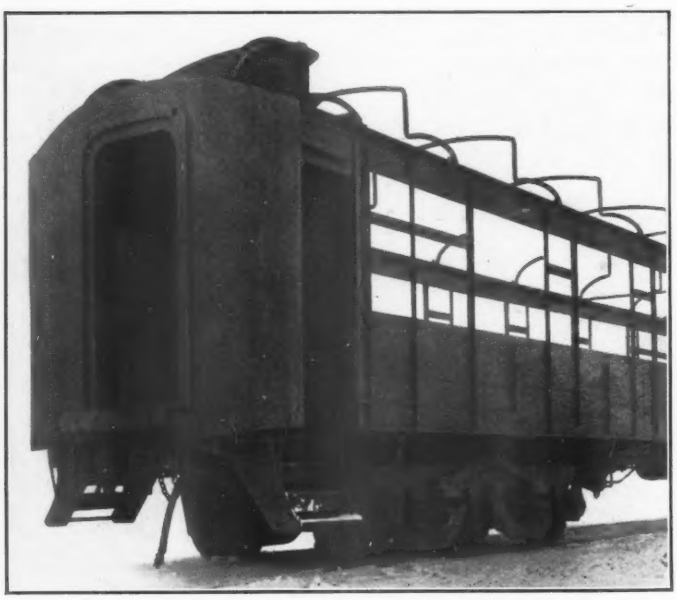
Interior of Canadian Northern Postal Cars

2½-in. by 3-in. wood support on the longitudinal center line ot the roof, and slopes each way from this line. Rubber packing ⅛-in. thick is used all around to insure weatherproof joints. A horizontal curtain, the roller of which is placed near one side of the opening, is operated by a cord hanging from the opposite side.

mon to all of the other classes, but so far as uniformity is possible all classes are similar.

UNDERFRAME

The principal longitudinal members of the underframe are two 15-in., 33-lb. rolled steel channels, 77 ft. 10½ in. long. Continuous top and bottom cover plates, 23 in. wide by 77 ft. 4⅛ in. in length and 68 ft. 4 in. in length, respectively, are riveted to the flanges of the center sills. The top plate has a thickness of ¼ in. and the bottom plate a thickness of 5/16 in. An additional top cover plate ¼ in. thick by 23 in. wide is applied for a dis-



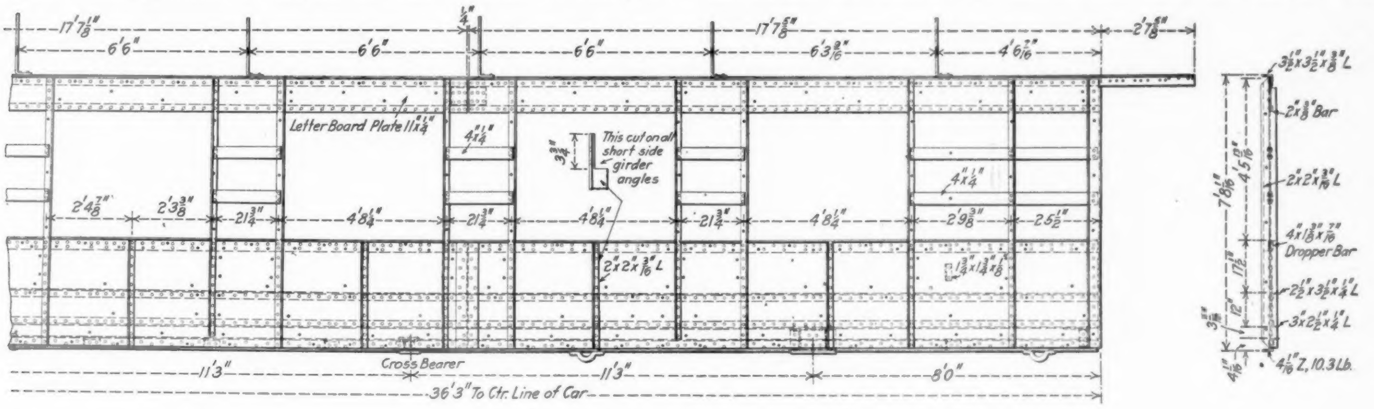
End View of the Dining Car Frame

tance of 12 ft. 6 in. each way from the transverse center line of the car. The draft lugs are riveted directly to the center sill, a Miner gear with a capacity of 150,000 lb. and a movement of 2⅛ in. being applied. The draft gear works in unison with the Standard Coupler Company's platform attachment, having a

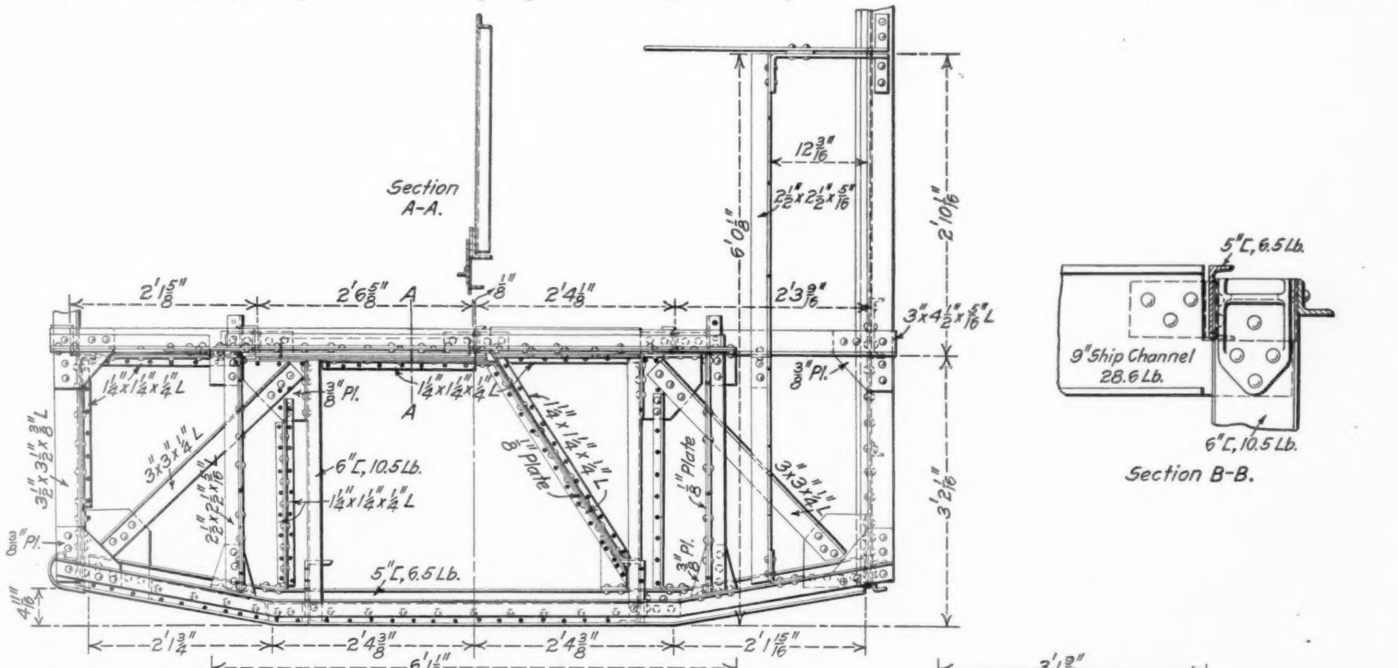
capacity of 42,000 lb. In addition to the capacity of the spring buffer and draft gear the center sill construction is designed to resist a buffing shock of 400,000 lb. with a factor of safety of 4½. The original cross sectional and flange area of the center sills has been restored by the use of reinforcing members wherever it was necessary to cut the sills to allow piping to pass through.

The end sills are ⅜-in. pressed steel diaphragms extending between the side and center sills. To the top flanges of these diaphragms is riveted a ⅜-in. plate, 12 in. wide, which extends across the underframe and forms part of the end sill.

The bolster is built up of ⅝-in. pressed steel diaphragms and top and bottom cover plates. The top cover plate has a thickness of ⅝ in. and the bottom a thickness of ⅞ in. The bolster diaphragms are spaced 9 in. back to back and have flanges 3 in. wide. The cover plates are 24 in. wide across the center sills, tapering to a width of 15 in. at the ends and riveted directly to the side girder construction. A steel filler casting is placed between the center sills where it forms a solid bearing for the body center plate. The center sills and side construction are further tied together by four crossties. These are made up of single ¼-in. pressed steel diaphragms and fillers to the top and bottom flanges of which are riveted cover plates 7 in. wide. The latter extend continuously from side sill to side sill, the thickness of



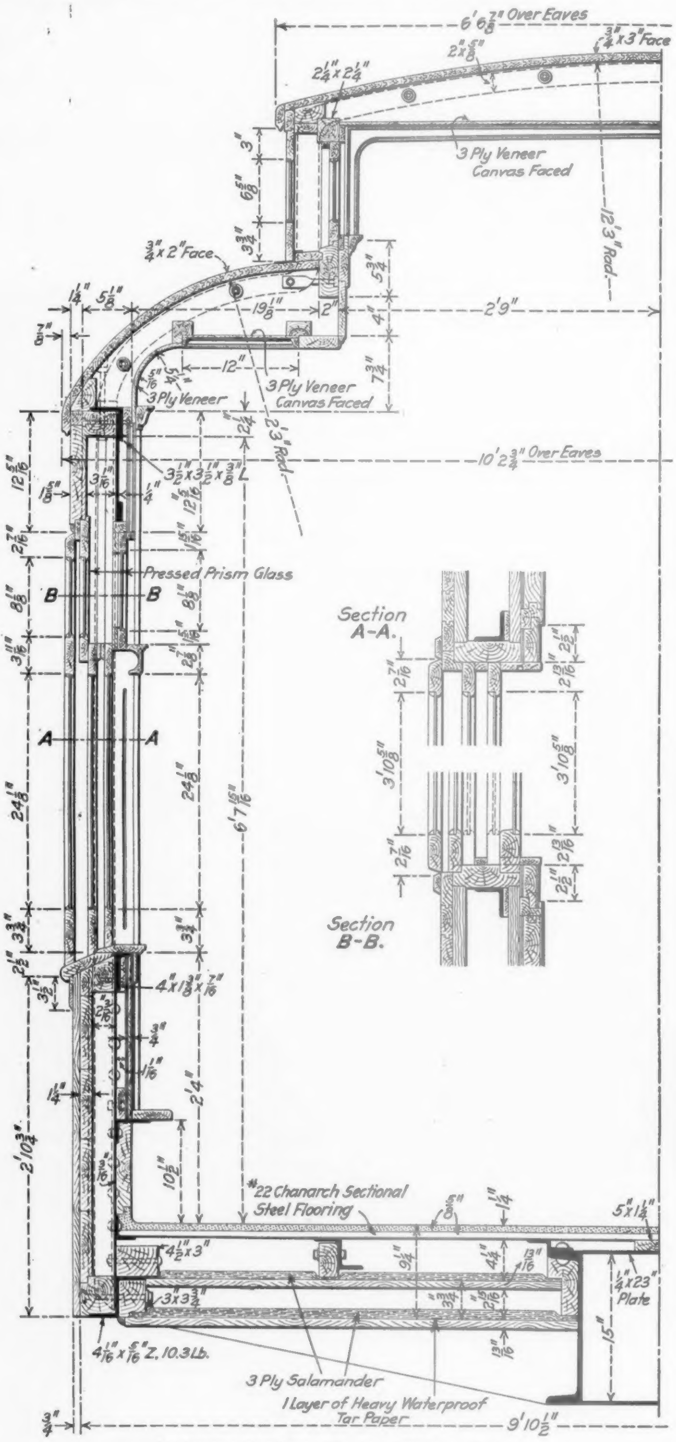
Steel Side Frame of the Dining Cars



Details of the Hood Construction; Canadian Northern Dining Cars

the top plates being 3/8 in. and the bottom plates 7/16 in. It has been found from experience in service that with this construction it is possible to support the center sill structure from the side sill girders so as to maintain the initial camber of 3/4-in. at the center of the car, the trucks being 56 ft. 6 in. apart between centers.

Pressed steel channels 3/16 in. thick secured at the ends to



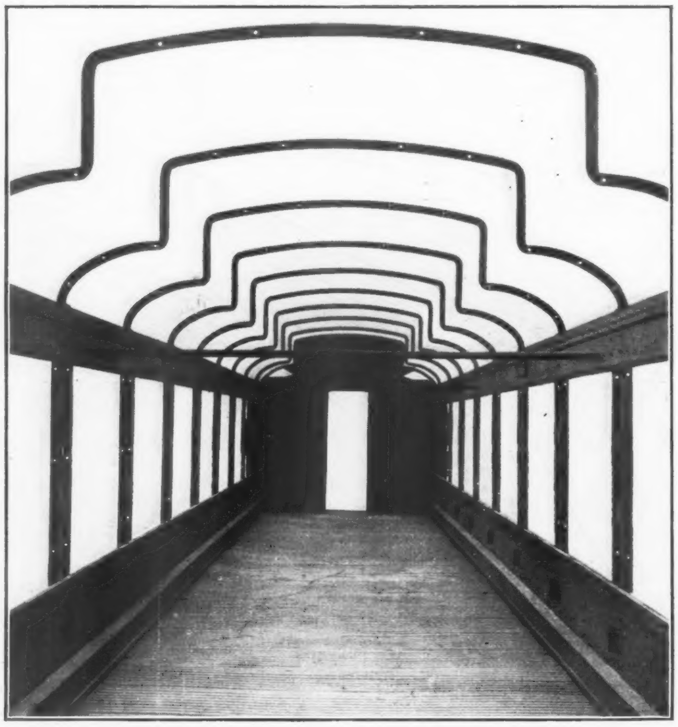
A Cross-Section of the Dining Cars

the center and side sills, serve as additional transverse floor supports. Intermediate longitudinal floor supports of 3-in., 6.7-lb. Z-bar sections are placed between the center sills and side girder construction.

Each corner of the underframe is braced diagonally from the corner to the intersection of the bolster and center sill by a 6-in., 10.5-lb. channel, placed with the flanges down. The platform end sill is an 8-in., 34-lb. H-beam, carefully fitted and attached to the end of the center sills by means of two 6-in. by 3-in. by 3/8-in. angle corner plates at each sill. The vestibule bumpers are U-sections pressed from 1/4-in. plate. They are secured to the backs of the 9-in. 28.6-lb. ship channel vestibule end posts, the lower ends of which form a part of the platform construction. The ends of the H-beam end sill are framed between the flanges of the ship channels, angle corner plates connecting the webs of the H-beam and the channels.

BODY CONSTRUCTION

The steel side frame is of girder construction with a bottom girder plate of 3/16-in. material extending to a height of 36 1/4 in. The letterboard plate is 1/4-in. thick and has a width of 11 in. The side frame has a total height of 7 ft. 8 3/16 in., the two girder plates being tied together by the 2-in. by 2-in. by 3/16-in. angle side posts. Angles of the same section are used between the posts as vertical stiffeners on the lower plate. The lower edge of this plate is riveted to the web of a 4-in. 10.3-lb. Z-bar side sill and at points 3 11/16 in. and 15 11/16 in. from the top of the side sill, measuring from flange to flange, are longitudinal angles of 3-in. by 2 1/2-in. by 1/4-in. and 2 1/2-in. by 3 1/2-in. by 1/4-in. section, respectively. The flange of the lower angle serves as a floor support, while that of the upper or truss plank angle extends out into the interior of the car at a point just over the



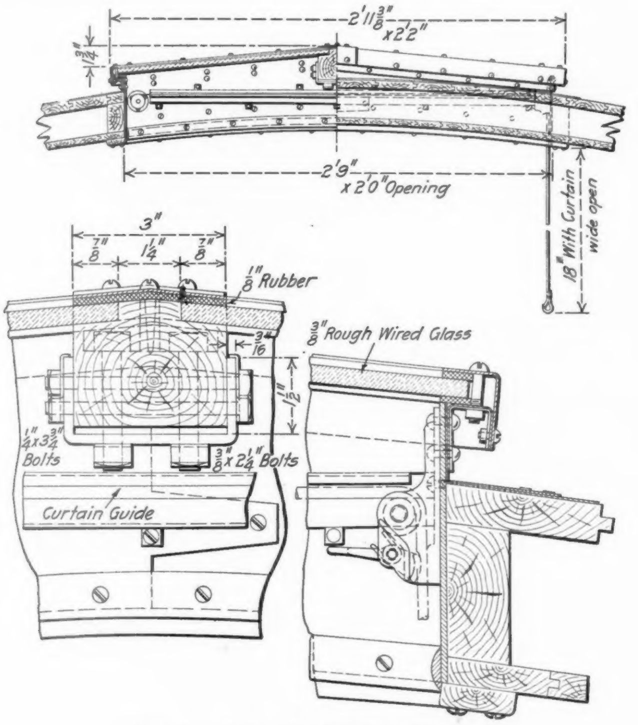
Interior of the Steel Frame; Canadian Northern Sleeping Cars

steam heat pipes. The top of the girder plate at the belt rail is stiffened by a 4-in. by 1 3/8-in. by 7/16-in. dropper bar, riveted on the inside.

To the top of the letterboard plate is secured the 3 1/2-in. by 3 1/2-in. by 3/8-in. angle side plate which extends throughout the length of the car, including the vestibules. The lower edge of the letterboard plate is stiffened with a rectangular bar of 2-in. by 3/8-in. section, riveted on the inside.

The body framing of all the passenger-carrying cars closely follows the arrangement of the dining cars, the variations being largely due to the difference in window arrangement. The arrangement of the postal and baggage cars differs considerably from this construction, however, in that the absence of side windows makes possible the use of diagonal braces between the side posts. This arrangement is illustrated by the photograph of the baggage car frames, which also shows the wood members to which the interior and exterior finish is secured, superimposed upon the steel frame.

The end frame at the kitchen end of the dining cars is made up of a 4-in. by 13.8-lb. Z-bar corner post on the passageway side, an end door post of 4-in. 8.2-lb. Z-bar section on the outside and 4-in. 7.25-lb. channel section at the partition side. The latter post is located practically on the longitudinal center line of the car. A channel post of the same section is placed at the corner of the kitchen refrigerator, which occupies one side of the



Details of the Postal Car Skylight

vestibule. The body corner post on the refrigerator side of the car is replaced by an 8-in. 13.75-lb. channel placed with the back parallel to the side of the car and the flanges out.

At the other end of the car the framing is symmetrical owing to the location of the end door on the center line. Here the corner posts are 4-in. 13.8-lb. Z-bars, and the intermediate posts are of the same section. The door posts are 4-in. 8.2-lb. Z-bars. All end posts are riveted to the outer face of the end sill, the whole construction forming an into-telescoping partition.

The hood construction is such as to form practically a horizontal girder by which any load against the upper part of the vestibule end posts is distributed to the side frames of the car. Light steel paneling entirely protects the upper deck against fire.

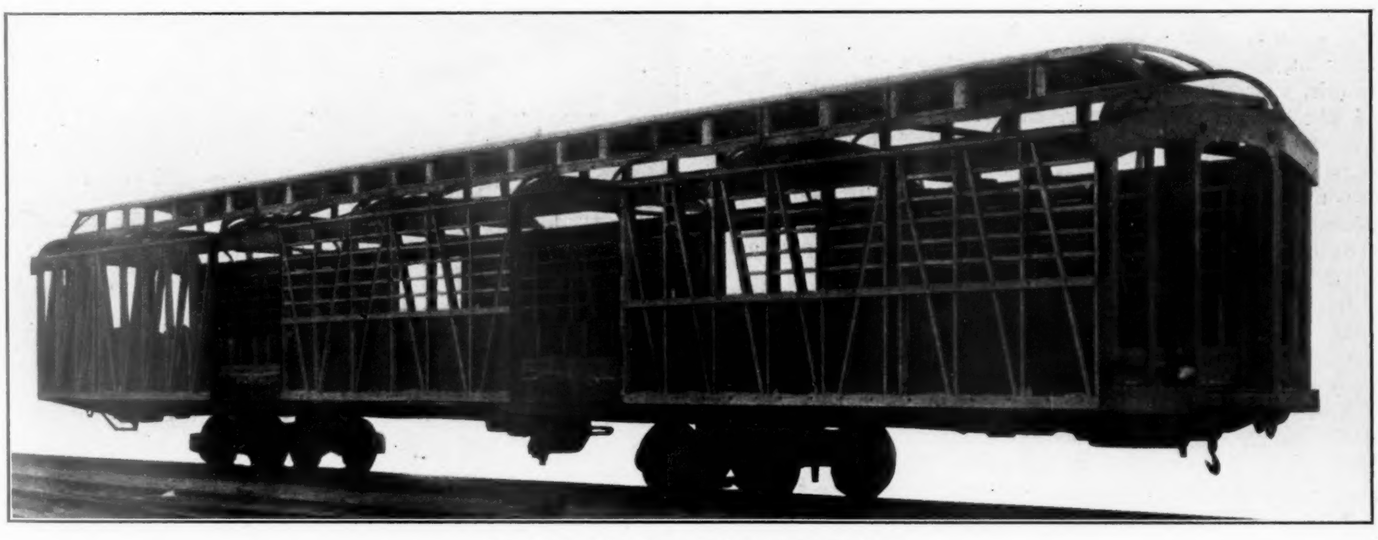
FINISH

Superimposed upon the steel framework is a practically complete wood frame carefully fitted together and bolted to the steel members. To this the interior and exterior finish of the car are applied in accordance with wood car practice. The result is a type of construction which has proved in service to retain the good qualities of a wood car without the slightest tendency toward squeaking. The latter result is largely contributed to by the ample use of quilted cotton for all contacts between the framing and finish.

The floor is of No. 22 Chanarch sectional steel flooring, which is laid directly upon the steel floor supporting angles and Z-bars. This is covered with a composition flooring made up of Magnesite, sawdust and magnesium chloride, which is laid to a thickness of 5/8 in. To facilitate the proper cleaning of the floor and to prevent water from reaching the steel framework, this material is extended up around the sides and ends of the car to a height of 1 in. In the dining car it was considered advisable to cover this material with a supplementary floor of cork 1/2-in. thick in order that the carpets might be removed during the summer months. Below the floor are two dead air spaces, the nailing strips for the insulating walls being bolted to the steel frame members. The lower wall is made up of a layer of 13/16-in. tongue and grooved material, upon which is placed one layer of heavy waterproof tar paper and a layer of 3-ply Salamander. The intermediate wall is similar to the lower one except that the layer of tar paper is omitted. A single layer of 3-ply Salamander is placed over the center sill, crossties and bolsters.

The deck is closed in tightly and glazed on account of the difficulty of keeping rain out where the deck sashes are not securely screwed in place. Special care is necessary to secure weather-tight joints, because the prevailing winds are north and south over a greater part of the transcontinental route. The roof is surfaced with No. 6 canvas, laid in white lead and oil.

The cars are equipped with 5-in. by 9-in. 6-wheel trucks of all-steel construction. The car body and the trucks are securely locked together by the use of the Coleman center pin in connection with a Wood roller center plate. Wood roller side bearings are also used.



The Body Framing of the Baggage Cars

In common with all railroads operating in northern climates, it is the practice of the Canadian Northern to use a combination heating system. The cars are equipped with the Gold Car Heating & Lighting Company's 2-in. by 1-in. duplex coil system of hot water circulation, it being possible to have both fire and steam in the heater at the same time.

The problem of keeping heater drips and basin and sink drains

from freezing in severe weather is one which has been difficult to solve. Trouble from drains freezing has been experienced even where pipes 1½ in. in diameter are used. All drains are now fitted with a simple thaw-out device adopted after a number of experiments. A 3-in. pipe sleeve, open at the lower end, surrounds the drain pipe where it passes through the floor and insulating walls. This is closed at the top, above the floor, with a cap to which is connected a ⅜-in. thaw-out line, taking steam through a special choke fitting from the steam train line. A globe valve in the thaw-out line permits the operation and control of the device from the interior of the car. In order to avoid uncoupling cars to thaw out frozen heater drips, all cars are equipped with a thaw-out hose steam connection and each baggage car carries 50 ft. of hose in a sealed locker for this use only.

The cars are provided with the Stone axle generator system of car lighting. Arnoldi ventilators are used, the dining car being equipped with enough of these ventilators, in connection with side intake ventilators, to provide ten changes of air per hour in the dining room. The kitchen is provided with a hood ventilator and an electric exhaust set together with two top deck vents, which provide for 20 changes of air per hour when standing or 35 changes per hour when running.

THE FOUNDATION BRAKE GEAR*

The most important parts of a brake, in my estimation, are the rods, levers, brake beams and attachments, through which the force is transmitted, and no matter how perfect are the brake shaft and its attachments, the triple valve and brake cylinder, the full effect of the brake is not realized, unless all other parts that transmit the pressure to the wheels are in good condition and in proper position.

The safety appliance law will compel inspectors to be familiar with the brake parts at the end of the car. The Master Car Builders' rules cover the up-keep of the triple valve and cylinder, but there are no rules prescribed governing the lengths of brake rods, neither is there any information given out generally outlining the proper proportion of brake levers and it appears to be a matter that inspectors and repairmen are not generally familiar with. Cars are placed on repair tracks and receive brake repairs and when completed, there is a possibility under present conditions of having a different brake pressure on each pair of wheels, which, no doubt, accounts, in many cases, for one pair of wheels sliding under a car. It is the practice to remove the triple valve for test when sliding occurs and if found in good condition it is replaced, but there are times when the leverage is not checked to see that the pressure is evenly distributed; then again, the man applying the brake rigging is very apt to apply rods and levers that bring the pressure far below the percentage which the car should have.

It is acknowledged that the greatest defect of hand brakes today is the uneven amount of slack in brake chains and until the brake rigging is properly applied and adjusted, it will continue to be a menace.

There is another thing which I believe has come to the attention of all car men and that is the use which is made of the dead lever guide. Its purpose is to take up the slack caused by brake shoe wear, but most repairmen utilize it to take up the slack existing in the levers, instead of adjusting the brakes at the bottom connection, thereby leaving no room to take up the brake shoe wear. When applying a top rod, extreme care should be taken to see that the push rod is forced back into the cylinder as far as it will go, and the cylinder lever is at right angles. Care should also be exercised to see that the push rod is up against the piston head; if not, it is too short. If the cylinder lever cannot be placed at the proper angle, because of the push rod striking the piston head, it is proof that the push rod is too long. Written instructions governing this class of work cannot very well be given to cover all classes of equipment and it is, therefore, the duty of the man following such work to educate himself to a point where he can tell at a glance what is wrong.

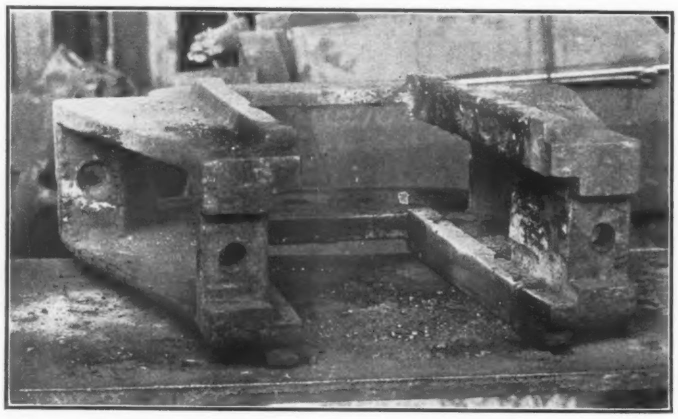
To determine the dimensions of levers to be used on a freight car, take 60 per cent of the light weight, which we will assume is 32,000 lb., giving a total braking power of 19,200 lb., and divided by 4 (the number of brake beams), which gives a load of 4,800 lb. on each beam. The truck lever dimensions usually employed are 8 in. by 24 in. Next multiply 4,800 by 8 and divide by the total length, 32 in., which gives a pull of 1,200 lb. on the top rod; this, multiplied by the total length of cylinder lever, which we will assume is 25 in., and divided by 3,700 lb. (which includes the pull on the top rod, plus 2,500 lb., the force exerted on piston), will give 8 4/37 in., or the length of the power arm of cylinder lever. Subtracting 8.11 in., the length of power arm, from the total length, leaves 16.89 in., the length of the other arm.

We should not lose sight of the fact that careful attention should be given to the brake lever key bolts to see if they are worn, and to brake levers, to determine if the holes are elongated, in which event they should be replaced. There are other things that cause too much slack in the brake rigging, such as worn brake heads, long body rods, short truck brake connections and loose cylinder and reservoir brackets. Careful attention should be given to detect these conditions and, of course, the matter of brake adjustment should be followed up at all times.

* From a paper by Chas. Page, Air Brake Inspector, New York Central, read at the October meeting of the Niagara Frontier Car Men's Association.

RECLAIMING CAR TRUCK PEDESTALS

The application of oxy-acetylene welding to worn passenger car pedestals is a practice followed by the Chicago, Burlington & Quincy at the Aurora shops. When the pedestals have worn to such an extent that it is impracticable to use them further, they are removed and the worn parts built up, as indicated in



Worn Jaws of Car Truck Pedestal Built Up by the Oxy-Acetylene Process

the illustration. The built-up surfaces are smoothed by grinding and the pedestals are then reapplied, being practically as good as an entirely new casting. The cost of thus repairing the pedestals is small and a substantial saving is made as compared with the cost of new castings.

SAFEGUARDING DANGEROUS DOORWAYS.—Doors are often located so that they open directly upon railroad tracks. In such cases prominent danger signs should be displayed; substantial railings should also be fixed in place, just outside the doors, to prevent persons from walking directly out upon the right-of-way. Similar railings should be placed wherever tracks come dangerously near to buildings, and if the space between a building and a track is so narrow that a person standing there might be crushed by a passing train, this space should be covered over by boards or by metal plates, inclined at such an angle that it is impossible for anyone to walk or stand in the region of danger.—*Travelers' Standard.*

REPORT OF I. C. C. DIVISION OF SAFETY

Defective Uncoupling Mechanism and Inoperative Brakes Criticised; More Supervision Needed

W. H. Belnap, chief of the division of safety of the Interstate Commerce Commission, in that part of his report for the year ended June 30, 1915, which refers to safety appliances, develops some facts which demand the attention of every car department officer. The following is taken from his report:

The number of inspectors has been increased during the year, making possible a substantial increase in the number of cars inspected. There is also an appreciable reduction in the proportion of the number of defects reported to the number of cars inspected as compared with previous years, which is partly explainable from the fact that the greater number of inspectors has made it possible to have each inspection point visited more frequently and partly from having heavier equipment placed in service and lighter equipment discontinued.

In order more graphically to show the results of inspections during the year, a comparison is here made of some of the figures for the fiscal years ending June 30, 1914 and 1915:

	1914	1915
Freight cars inspected	790,822	1,000,210
Percent defective	5.79	4.77
Passenger cars inspected	26,746	33,427
Percent defective	1.04	2.85
Locomotives inspected	32,761	38,784
Percent defective	4.98	4.06
Number of defects per 1,000 inspected	67.48	57.23

The decrease of 1.02 in the percentage of defective freight cars is most gratifying, especially in view of the fact that in addition to maintaining appliances in operative condition carriers have been charged with the duty of standardizing their old equipment. The increase in the percentage of defective passenger cars was occasioned by the fact that on July 1, 1914, the extension of time granted by the commission for bringing this class of equipment to the standard prescribed expired.

DEFECTIVE UNCOUPLING MECHANISM

The number of defects reported in coupling and uncoupling mechanism directs attention to the necessity of a system of rigid inspection if these parts are at all times to be kept in proper condition. The master Car Builders' Association is continuing its efforts to develop and secure the adoption of a standard coupler. The report of the committee on couplers of the association is an interesting commentary on the results secured in tests of the present types of couplers and the two experimental ones that are being tried out. The use of many different kinds of couplers, some of doubtful efficiency, and the consequent difficulty in securing their proper maintenance and repair is a prolific cause of injury to employees, as well as one of the principal causes of prosecution for violation of the safety appliance acts. The adoption of a thoroughly tested coupler, which will combine the qualities of efficiency, simplicity, and strength, can not be too strongly commended.

Experience has shown that a material percentage of defective and inoperative couplers is now caused by using wrong parts in making repairs. It is apparent that repairmen are not familiar with the different parts of the various couplers, or else have not been provided with the proper material with which to replace defective parts when repairs are necessary. The result is that after a short period these improper repairs become defective and the coupling mechanism becomes inoperative. Repairs of this character when made are almost impossible to detect unless the cars are separated and the couplers carefully examined.

The general lack of efficiency of many of the designs of uncoupling mechanism is cause for grave concern, for while there has been a large decrease in the number of broken and kinked chains, these defects, which render the mechanism totally inoperative, constitute 50 per cent of all the defects under the heading "uncoupling mechanism." Defects of this character could be corrected by the use of any device having rigid connection of the lever and the lock or lock lift, thus eliminating the troublesome chains and doing away with the chief cause for prosecution under the safety appliance acts. The importance of eliminating many of the defects inherent in certain of the uncoupling mechanisms now in use can not be too strongly urged.

RUNNING BOARD CONDITIONS IMPROVED

During the past year there have been fewer causes for criticism with regard to the manner of applying running boards to saddle blocks than have been noted in former years, which evinces a better understanding of the commission's order, in that there are now found comparatively few cases where running boards have been applied with fluted nails or drive screws. There exists, however, a tendency to drive the screws, with which the order prescribes the boards may be fastened. A few cars now being put in service have their running boards secured with bolts, which represents the ideal secure fastening required by the law.

POWER BRAKES IN OPERATIVE CONDITION

The opinion recently rendered in the case of the Virginian Railway Co. *v.* The United States of America is most important and its effect will be far-reaching. The decision in this case was to the effect that trains must be controlled by the power brakes prescribed by law, and that even though there be 100 per cent of the power brakes in the train in operative condition, the use of the hand brakes for the purpose of controlling the speed of the train is unlawful. It was further held that just as the object of the automatic coupler is to keep employees from going between the cars, so the object of the train brake is to keep employees from going on top of trains to set and release hand brakes. The hand brake is an important feature of the equipment of every car, as it is necessary in controlling the speed of cars being set onto sidings and made up into trains. Another recent hand-brake decision of importance defines the word "efficient," as used in the statute as comprehending the efficiency of the hand brake for the purpose of holding a car or train, as well as its efficiency as a matter of safety to employees engaged in work requiring the use of hand brakes.

The maintenance of the power brake on each car in proper condition is the only hope for alleviating the power-brake troubles in the operation of trains. Many of the railroads are now insistent in their demands for 100 per cent efficiency in the operation of train brakes leaving terminals, and seem to be experiencing no particular difficulty in securing it. However, by far the greater majority of the roads operate their trains under the assumption that in having 85 per cent of the cars in such trains with power brakes in operative condition they are meeting all the requirements of the law on this point. It is clearly manifest that the intention of the commission as set forth in its order of June 6, 1910, was plainly that all power-braked cars in trains should have their brakes used and operated from the locomotive drawing the train, and several suits have been instituted that this part of the law may be tested in the courts.

Only by a careful system of inspection and through test at terminals can 100 per cent efficiency of brakes be secured, and it is not unreasonable to demand that such careful test and inspection be made. Each brake should be tested so as to know if the piston moves forward enough to close the leakage groove, and not more than 10 in. when a full service brake application is made from at least a 70-lb. brake pipe pressure, and remain so until the usual inspection is made, releasing properly by the ordinary method in making terminal tests. Working toward this end, it is

gratifying to note that the carriers are educating their inspectors in the more efficient discharge of their duties and are securing men who have a better knowledge of the complicated brake systems and the problems in maintaining them. However, the proper means of making tests of brakes must be provided, so that cars may be tested before they go forward.

The need of efficiently operated brakes continually becomes more pressing, owing to the constantly increasing length of trains on level roads and the ever increasing tonnage handled on railroads with heavy grades. As the length of trains increases the difficulty of maintaining power brakes increases.

Owing to defective connection, leaky train pipes, and train pipe friction, with trains the length of many now handled daily on some railroads, it is extremely difficult to maintain adequate brake pipe pressure on the rear of the train. This condition is a source of danger, as smooth, uniform, and safe handling of the air brake system is not possible where there is such variation in train line pressure as has been found to exist.

An air brake gage in the caboose, together with a conductor's valve that is readily available in case of emergency, is important for the proper handling of long trains. Without this gage to indicate the train-line pressure, the trainmen on the rear of the train are in ignorance of the air pressure available for use and have no means of knowing with certainty whether their trains have sufficient air in reserve properly to control them.

Disregard for the law or misunderstanding of the proviso of section 6 of the act of 1893, as amended, is still shown by cases reported of the indiscriminate handling of logging cars having drawbars of various heights in connection with other equipment. The language of this proviso is so plain that there appears to be no justification for any violation of it.

The handling of chained up cars in revenue trains or in connection with cars commercially used is less prevalent now than heretofore, but occasional instances are still reported. The proviso in the act of 1910 does not permit the hauling of defective cars by means of chains instead of drawbars in revenue trains, or in association with other cars commercially used, unless such defective cars contain live stock or perishable freight, and any violations that are discovered are presented for prosecution.

Quite a number of cars have been found equipped with handholds less than 16 in. in clear length, there being nothing to prevent the application of 16-in. handholds if the carrier desired to use them. The order permits the use of 14-in. handholds only where it is impossible to apply those 16 in. in length.

INTERCHANGE OF EQUIPMENT

Owing to the lack of familiarity on the part of many employees with the requirements of the safety appliance laws, the matter of interchange of equipment continues to produce much controversy and misunderstanding. Under the decisions of the courts any movement of a car with defective safety appliances subjects the carrier to the statutory penalty unless it is such a movement as comes within the proviso of section 4 of the act of April 14, 1910. This proviso permits a carrier to make a movement for the purpose of repair only where a car becomes defective while being used on this line of railroad, and then only from the point where it is first discovered to be defective to the nearest available point where it can be repaired, provided further that such movement is necessary to make such repairs and that such repairs can not be made except at such repair point. Notwithstanding the plain provision of the law that the right to move a defective car for the purpose of repair is limited to the carrier upon whose line of railway the car becomes defective, cars are delivered and received in interchange and subsequently moved for the purpose of repair. The mere fact that the movement of traffic will be facilitated and congestion prevented does not warrant the movement under such circumstances of cars not in the condition required by law. A railroad is under no obligation to receive defective cars from connecting lines; but if it does so, it can not thereafter lawfully move such cars even for the purpose of repair. In order to escape the statutory penalty they must be repaired where they stand and can not be otherwise used or switched about in its yards. Many defects are of such a nature that they can be readily repaired on the interchange track and no real necessity exists for their further movement in defective condition. Some complaint is heard of the alleged hardship occasioned by the receiving line's refusing to accept cars with defects which can not be repaired on the interchange track and by so doing requiring the delivering line to return the car to its own repair track. Such deliveries are often made regardless of the condition of the safety appliances and for the sole purpose of expediting the movement of the freight. Where the carrier knows, or upon a proper inspection should know, the condition of the car, and is so unmindful of the duty imposed upon it by the statute, it can not be heard to complain. It is believed, however, that in a majority of instances defects of this character would be discovered by a careful inspection of the cars before they are moved to the interchange track. Often too little attention is paid to apparently unimportant defects with the result that minor defects on cars leaving the yards often lead to more serious defects by the time they reach the interchange track.

GENERAL TRAVELING INSPECTORS

A better understanding on the part of railroad employees of the requirements of the law and the methods of making proper repairs will go far toward minimizing many of the present difficulties. Several of the railroads have general traveling inspectors who go from one inspection point to another, consulting with the inspectors and repairmen, and giving instructions and advice on the many technical questions that so frequently arise. The results of this educational method have been most gratifying, and it is to be hoped that such methods of improving safety appliance conditions will be more generally adopted.

Prosecutions for the movement of defective cars are not instituted with the idea of imposing undue hardship upon the carriers, but because experience has demonstrated that prosecutions are often necessary to secure compliance with the statute. It is believed that a better understanding of the methods employed in the inspection of safety appliances would lead to more cooperation on part of the carriers. Under the policy followed from the inception of our inspection force, by far the greater portion of our inspectors' time has been devoted to inspecting equipment in the yards, accompanied by representatives of the carriers. During these inspections all safety appliance defects are brought to the attention of the representative of the carrier and an explanation is made of the requirements of the law as set forth in the printed pamphlets distributed by the commission. Monthly reports of these inspections are sent to the presidents of the various railroad companies, directing their attention to any defects that may have been found in their equipment. Where conditions indicate a continuing disregard of the law or a lack of vigilance in inspecting and repairing equipment, inspectors secure evidence for prosecution and in obtaining this evidence do not make themselves known to the representatives of the railroad companies, for, as pointed out in the decisions of the courts, if inspectors were required to notify the carrier of the defective condition of a car before it was moved it would be impossible to secure effective enforcement of the statute.

Inspectors enter upon every investigation with a desire to perform their duty as officials directed to aid in the execution and enforcement of the law, and the prosecutions instituted by no means represent isolated instances of failure to comply with the requirements of the statute. A suit to recover the statutory penalty is filed only in a case of manifest dereliction of duty.

Much of the improvement in the direction of proper compliance with the provisions of the safety appliance laws has been accomplished through the spirit of hearty cooperation manifested on part of the carriers. In most instances our inspectors are shown every courtesy, and their suggestions as to the proper application and maintenance of safety appliances receive careful attention. Employees engaged in the work of car maintenance take considerable pride in having satisfactory reports made on the conditions found to exist in their yards and this spirit accounts in a great measure for the betterment in conditions.

THE CAR INSPECTOR AND HIS JOB

A Combination of Articles Received from Seven Contributors to the Car Inspectors' Competition

Each of the last three issues of this journal contained articles that were submitted in the car inspectors' competition, which closed October 1, 1915. This article is a combination of the papers submitted by seven contributors, located in various parts of the country from New England to Kansas. These seven contributors are C. L. Bundy, general foreman, Delaware, Lackawanna & Western, Kingsland, N. J.; W. T. Clanton, car foreman, Illinois Central, Cairo, Ill.; G. H. Heiter, chief car inspector, Louisville & Nashville, Mobile, Ohio; H. T. Mabry, car clerk, Atchison, Topeka & Santa Fe, Topeka, Kan.; John C. Murdock, Boston & Albany, Allston, Mass.; W. W. Warner, foreman car department, Erie Railroad, Cleveland, Ohio; and W. G. Walker, car inspector, Chesapeake & Ohio, Silver Grove, Ky.

IMPORTANCE OF SELECTION

Those who have had experience in handling men will concede that it is next to impossible to train them to perform satisfactorily any duty or work that they dislike. Experience teaches us to select men with great care for positions of any real importance. Much valuable time and money will be wasted in trying to educate a man to be a car inspector if he does not like this kind of work at the start.—(*W. W. Warner.*)

RESPONSIBILITY FOR TRAINING

The statement has been made that it is difficult to procure capable men for the position of car inspector. If it is true there must be something wrong with the organization of the car department as a whole. We may examine this statement from an American point of view. "If you would be well served, be your own servant." Good capable men are not like a mushroom and do not grow over night. They must be developed. If you want good men, serve yourself with them by having a system of your own to develop them. You will then know they are good, as you know the conditions under which they received their training. You also have developed yourself into a position where you do not have to depend on men of whom you yourself have no knowledge.—(*John C. Murdock.*)

THE INSPECTOR'S RESPONSIBILITY

The M. C. B. rules represent the laws governing the joint responsibility of foreign roads to home lines. If the inspector is not capable, or is slack in the performance of his duty, the road he represents carries a high expense account which should be reduced by damages paid by other roads under the M. C. B. rules.—(*John C. Murdock.*)

Most of the tonnage carried is destined to points off the line originating it and cars therefore must pass the inspectors of a number of different roads in getting to their destination. It is therefore necessary, for the prompt movement of freight, to have good broad gaged common sense inspectors. Cars should be held up only when their condition is such that they are not in safe condition to go forward.—(*C. L. Bundy.*)

COMPLICATION OF RULES

While the M. C. B. rules governing the interchange of cars are based on business principles, they are all more or less complicated and different interpretations are placed on different rules by different men. It is necessary for the M. C. B. Association to have a committee, known as the Arbitration Committee, to pass on all disputes referred to it for settlement and it is often called upon to settle cases referred to it for a decision. —(*C. L. Bundy.*)

The car inspector is required to work 11 or 12 hours a day, with very little time to study the rules, or to keep posted on the different duties that he has to perform. If he was on an eight-hour shift it would give him time to study the rules, and keep well posted on safety appliances, combination defects, use of wheel and coupler gage, etc. The interchange rules are hard to understand if an inspector does not take a great deal of time to study them out; in fact, many of them are apparently conflicting, if not thoroughly understood.—(*W. T. Clanton.*)

QUALIFICATIONS OF CAR INSPECTOR

A car inspector should be able to read and write fairly well; should have good eyesight, so that he may be able to see defects if they exist; should be physically able to get around and climb over cars in making inspections; should be industrious, as there is no room for the lazy fellow; should be of a good disposition in order to get along with inspectors of other lines, and his hearing should be good.—(*C. L. Bundy.*)

A car inspector should have a good character, the trait of observing, and a desire to do unto the other inspector as he wishes to be done by. Too many interchange inspectors get the idea that their employer wants them to try to "put it over on the other fellow" whenever he gets a chance. This is entirely wrong. Whenever a car is held up it means that a shipment is being held, if it is a loaded car, or, possibly, if it is an empty, some shipper is holding his shipment until the car arrives; in any case some one will have to pay the per deim.—(*W. W. Warner.*)

An inspector should possess good health, be energetic, not a shirk, have a fair education so that his reports of defects existing on cars inspected can be understood by others who handle them, a quick eye, a good memory, and good judgment.—(*H. T. Mabry.*)

He should be a man with a disposition to get along agreeably with his neighbors—the inspectors on other roads who inspect cars against him. If not, he will find many cars held up by them for minor defects that would be perfectly safe to run; as a result important freight will be held up. I feel that this is one of the most needful qualifications of a car inspector—to get along with the other fellow and give and take a little, as it were, in order to keep cars moving through to their destinations. —(*C. L. Bundy.*)

A man who deserves to become a car inspector should possess a common school education that he may acquire the proper knowledge and conception of the various codes of rules pertaining to the position. He should be a man whose honesty and integrity will at no time be questioned by his superior officers. His habits must be good. He must not be given to the use of intoxicants. He must be studious, industrious and constantly on the alert, and at all times mean business.—(*G. H. Heiter.*)

In addition to being a young man, he should be able to read and write fairly well, at least; he should have a keen eye for detecting cracked wheels, loose wheels, cracked arch bars and many other similar defects; he should be somewhat athletic, as there is considerable climbing over cars in making inspections.—(*C. L. Bundy.*)

KNOWLEDGE REQUIRED

A car inspector should know the parts of a car, and their value to the car as to safety. He should be conversant with the M. C. B. rules, Arbitration Committee decisions, and all circular matter pertaining to the interchange of and running of cars. He should know when open cars are properly loaded, single, or in group; be familiar with the U. S. safety appliance standards; also able to pass on high cars, and the heighth and width of loads on open cars to pass published clearances. He should be able to select a suitable car for all kinds of commodities, particularly explosives and inflammable material; be able

to determine the nature and extent of needed repairs, to make cars safe for trainmen, and safe in regular train service. He should possess decisive power, and exercise good judgment to facilitate the movement of freight.—(*E. G. Walker.*)

TRAINING

Much depends on the method pursued for developing men for this kind of work. We cannot place an inexperienced man on an interchange and expect him to make good from the start. We must give him an opportunity to learn the method of inspecting cars, the proper interpretation of the M. C. B. rules, etc. This can best be done by placing a new man with an experienced one who has enough interest in his fellow man to give him the necessary instructions and advice. Success or failure depends very much on the kind of a start that the new man gets. If he is impressed with the importance of his part of the work and is given the proper instructions and has the right qualifications he will be a success.—(*W. W. Warner.*)

Put bright young men about 25 years of age in the shop or repair yard, working on all kinds of cars, for about one year at least, preferably two years; then place them with an experienced car inspector in the yards inspecting cars.—(*C. L. Bundy.*)

The car inspector should be selected from young, energetic, sober men on the repair tracks. Here he acquires the knowledge of different parts of cars, their location, and as to whether repairs are properly made standard to the car. He should be perfectly familiar with this work. Then he should be given the M. C. B. rules; M. C. B. loading rules, and U. S. safety appliance regulations, so he can familiarize himself with the rules governing the interchange of cars. He should then be placed with an experienced interchange inspector, who can explain the rules, and teach him their meaning and workings. This can be done by reading the rules, one at a time, and explaining them; then see that he understands each rule, also that he thoroughly understands what constitutes a combination of defects, what are delivering line, or owners' defects. Also explain thoroughly the use of the billing repair card; M. C. B. defect card; joint evidence card; the partial repair card, and cardable defects.—(*W. T. Clanton.*)

A man should serve not less than six months in a car shop, for it is there that he has the opportunity to become familiar with the various parts of cars from the rail to the running board. He learns how to frame and construct; he becomes familiar with all the standards of material, and where it belongs. From the shops he should go into the yards with a reliable inspector, where he can be instructed in the daily practice of inspecting trains in and outbound.—(*G. H. Heiter.*)

The car inspector must have a training in car construction and repairs by actual experience under a qualified foreman, also a theoretical knowledge of the rules governing the condition of, and repairs to freight cars for the interchange of traffic. Thus qualified and trained he should be placed under the supervision of an experienced and qualified inspector that he may gain experience in the interpretation and application of the rules by actual inspection and application.—(*H. T. Mabry.*)

The car foreman, general foreman, or master mechanic, should call all of his inspectors together once each month, or oftener, and go over the most difficult rules, or the ones that are not thoroughly understood.—(*W. T. Clanton.*)

Send them to M. C. B. conventions and furnish them with reading material to add to their knowledge.—(*John C. Murdock.*)

DUTIES

The terminal inspectors' duties are to inspect all cars in trains as they arrive at the terminal, marking out such cars as are found to be in bad order. While it is not absolutely necessary for them to be experts on the M. C. B. rules of interchange, it is well for them to be fairly well posted in this respect. Inspectors at interchange points should be well posted on the M. C. B. rules of interchange, in addition to their other qualifications, which include all the qualifications of the terminal inspectors. There are so many things for car inspectors to look after that it is hard to outline all of them. The most important thing, in addition to inspecting cars, is to keep a thorough record of all cars delivered from one road to the other. This record should show dates, car numbers and initials and defects, if any; also record of M. C. B. defect cards, if car is so carded. He should be able also to furnish the proper information for billing on all work done to foreign cars.—(*C. L. Bundy.*)

EXAMINATIONS

The car department should examine its men on the M. C. B. rules and rate them on a percentage basis. In case of vacancy in the inspection force promote the man with the highest percentage.—(*John C. Murdock.*)

The responsibilities that inspectors have are such that means should be employed to know their qualifications and fitness, and by examinations to determine the extent of their knowledge of the rules, thus inducing them to keep posted and up to date. The incompetent and non-progressive inspectors can thus be located and eliminated.—(*H. T. Mabry.*)

HELPING THE INSPECTOR

At some of the large interchange points local rules governing the interchange of cars have been put in force with good results. If the railroads would institute a rigid inspection of all cars while they are empty and have needed repairs made, most of the difficulty would be overcome and the poor car inspector would be relieved of much of his trouble.—(*C. L. Bundy.*)

COMPENSATION

There are few persons who are natural students and who study for the sake of knowledge only. In order to make inspection positions attractive they must be rated higher as far as wages are concerned. There must be some inducement to encourage men to give up their leisure time outside of working hours to study. Take the locomotive firemen who have to pass first, second and third year examinations on mechanical subjects, also one on train rules and air brakes. Many give this work up, even with the prospect of higher wages, because they must pass a certain percentage to become eligible for engineers. —(*John C. Murdock.*)

The M. C. B. rules, because of the varied conditions which they have to cover, have become so complicated and interlocked that only the men who are qualified and trained can understand and apply them properly. To secure and retain competent men for inspectors adequate compensation should be paid them, thus inducing the inspectors to appreciate and strive to retain their positions by faithful service.—(*H. T. Mabry.*)

The master mechanic should offer the inspector every opportunity possible, as the better posted the inspector is the better service he will render. Great responsibilities are placed on his shoulders, and he should report to, and receive instructions from the proper source in the mechanical department, and not from officers in some other department. Then he should be paid well for his work and enjoy a vacation each year, the same as other salaried men.—(*W. T. Clanton.*)

PROMOTION

The car inspector has opportunities for advancement equal to any employee in the car department. He can rise to the position of chief inspector, chief joint inspector, general inspector, car foreman, general foreman and many other positions of importance. In order to do this, however, it is necessary to keep up with the times, be constantly on the job, have a determination to win, and live strictly up to the instructions.—(*W. W. Warner.*)

A man that is thoroughly familiar with the rules and proficient in the discharge of his duty will certainly prove qualified for greater responsibility.—(*G. H. Heiter.*)

By giving him opportunities to attend conventions and meetings with chief joint car inspectors and car foremen, he can grasp many different ideas that will help to develop his mind so he can in the future fit himself for car foreman, or a chief joint car inspector, or perhaps a travelling car inspector, and even superintendent of the car department.—(*W. T. Clanton.*)

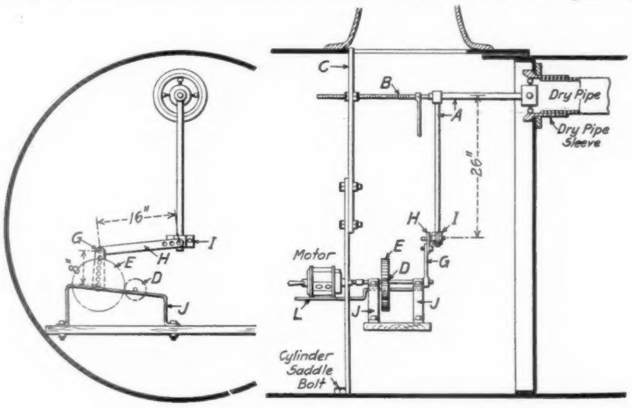
SHOP PRACTICE

GRINDING DRY PIPES

BY V. T. KROPIDLOWSKI

The grinding of steam and dry pipe joints is a big item of back shop expense. In a shop with an average output of 25 locomotives per month the pay roll of the steam pipe gang amounts to about $400 a month. To be able to grind in fourteen sets of pipes in a month a gang of six men cannot meet with many bad joints. From these considerations it is evident that any means which can be devised that will facilitate the grinding of joints will effect considerable saving.

The illustration shows a device for grinding dry pipe joints on the front tube sheet, which is designed to be set up in the front end. The original crank used for grinding by hand is shown at *A*. The feed screw *B* and brace *C* are also part of the hand equipment. A Little Giant No. 2 air motor furnishes the power, the speed being reduced two and one-half times by the gears *D* and *E*, from a motor speed of about 125 r.p.m. A Morse taper shank is welded on the end of the small gear shaft, to which the motor is attached. To the end of the large gear shaft a crank arm *G* is fitted. This is held in place by a set screw and imparts oscillating motion to the crank *A* through the link connection *H*.



Motor Attachment for Grinding Dry Pipes

The construction is simple and, therefore, inexpensive. The gears are of cast iron with 1¼-in. faces, the large one having a pitch diameter of 10½ in. and 106 teeth, the small one having a pitch diameter of 4 in. and 40 teeth. The gear shafts are ⅞ in. diameter, and run in small cast iron boxes, reclaimed from scrap and babbitted. The crank arm is made from a straight bar of merchant iron ⅝ in. by 1½ in., upset on one end for the shaft fit. A number of 9/16-in. holes drilled 1 in. apart permit the adjustment of the stroke. The link *H* is of ½-in. by 1½-in. bar iron, with three 9/16-in. holes for the adjustment necessitated by the difference in the diameters of front ends. The clamp *I* is made in two halves, one having a trunnion welded on and finished, so that it will work smoothly in the holes of the link. The frame *J* is of ⅜-in. by 2-in. iron. The bar *L* is provided for the motor to rest on and can be removed at any time, as it is merely secured to the frame with eye bolts. The whole machine is mounted on a 2-in. by 12-in. plank, 4 ft. 3 in. long, and can be handled and moved about by one man.

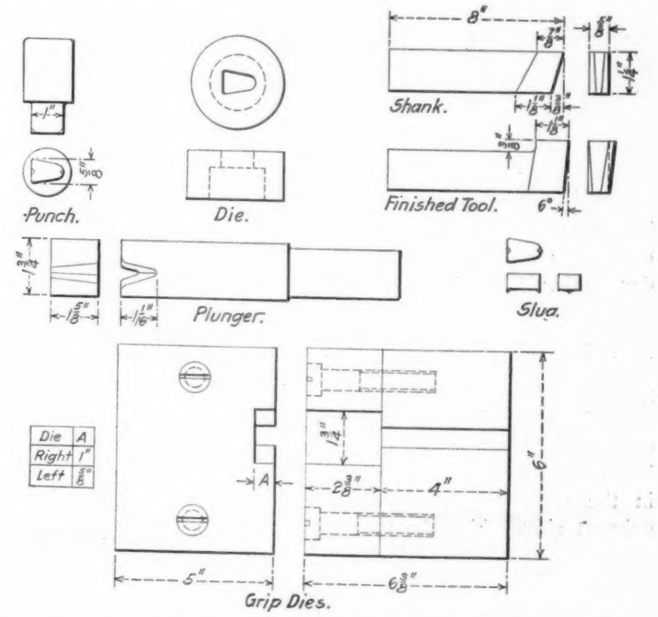
Joints requiring from 10 to 12 hours by hand, with this machine can be done in one-half the time. This relation will not hold, however, as the time required by hand becomes less. Where a joint requires only four or five hours of hand grinding, with the machine it cannot be finished in two or two and one-half hours, because the time used in setting up, inspecting and filing the joints, etc., is the same regardless of the amount of grinding to be done. The machine eliminates one man in many cases. Where the dry pipe is so hung that when pulled forward for inspection of the joint, the back end of the pipe is pulled out of the hanger, two men are needed, one in the dome to support the back end of the pipe every time it is pulled forward for inspection and filing of the soulder on the joint.

WELDING HIGH SPEED STEEL TO SOFT STEEL SHANKS

BY H. W. HARRIS

The drawing shows a tool for use in lathes, planers or shapers, with a high speed steel cutting edge and soft steel shank. The welding is done in a forging machine, the high speed steel tip being welded on top of the shank so that it is backed up by the soft steel in the direction of the cutting strain.

The high speed steel tips are punched in the form of slugs by means of the punch and die shown in the illustration. Two small recesses or nicks are provided in the cutting edge of the punch, which cause the formation of slight fins on the slug. The soft



Forging Machine Dies for Welding High Speed Steel Slugs to Soft Steel Shanks

steel shank is tapered at the end to about the form of the slug. When a supply of shanks and slugs is ready the grip dies and plunger are applied to an Ajax forging machine, which is used to weld and finish the tools.

After the end of the shank has been raised to a welding temperature in an oil furnace it is covered with welding compound and the high speed steel slug applied to it. The slug is held in position by a light blow from a hand hammer which presses the fins into the hot metal. The two pieces of metal are again raised to a welding temperature and the tool inserted in the forging machine, where it is welded and finished with one stroke of the machine. When removed from the machine the tool is placed over an air blast and hardened, the flash being knocked off when cold. After grinding, the tool is ready for use.

This method of welding the two materials possesses three distinct advantages over hand welding. First, by making the

tools in quantities the cost of each tool is materially reduced by the use of the machine. Second, the pressure of the forging machine produces a dense, close grained tool. The last and most important advantage is the production of a better weld. Considerable difficulty has been encountered with the hand welded tools, the uncertainty of the welds resulting in frequent failures under heavy cuts.

PISTON VALVE PACKING RINGS*

BY JOHN C. MURDOCK

The most important feature of the piston valve ring is to have it steam tight. The steam and exhaust edges must be perfectly tight both at the beginning of admission, at the point of cut-off, beginning of release, and at the point where compression begins. The L-ring may be taken as a good example of mechanical construction of a ring that permits the free movement of the steam at the moment of admission and release. The L-ring, projecting out over the side of the groove, is sufficiently wide to cover the wall of the groove, thus permitting the free flow of steam and at the same time presents a steam tight edge square with cylinder wall. If the rectangular ring were used it may be seen that as the edge of the ring clears the steam port the flow would be obstructed or deflected by the wall of the ring groove.

The T-ring is a more elaborate development of the L-ring. The tendency of the L-ring is to show a lighter bearing at its thin edge on account of being backed up by less stock when it is sprung into its place. The T-ring overcomes this tendency. The Z-ring provides more in the nature of a plug fit and while this has some advantages it also has some disadvantages, as, for instance, with water in the cylinders it will take more pressure to pass the water by the rings. Taken as a whole, it is doubtful if any will show virtues enough to make up for the simplicity of the L-ring if it is properly made and maintained.

The packing rings at the steam edge of the valve give very little trouble from leakage, since the pressure of the steam is on them all the time and holds them firmly against the cylinder walls. The rings on the exhaust side are the ones that give the most trouble and interfere with the economy of the engine. From the steam distribution standpoint the economy in fuel is governed by the point of release and if the valve is properly constructed the packing rings that control the release must be maintained as tight as possible. At the moment of cut-off the steam ring, being in the port and surrounded or balanced in the steam, leaves all the work of holding the steam in the cylinder until it does its work by expansion, to the exhaust ring. Also the pressure from within the cylinder acts on the exposed part of the exhaust ring with a tendency to compress it and cause release to begin the moment enough of its area is exposed to the pressure in the cylinder to overbalance the exhaust pressure on the opposite side of the ring plus the spring tension of the ring.

The exhaust ring should be a perfect fit in the cylinder and never have less than 1/8-in. spring for a 12-in. diameter bushing. No expense should be spared in making this ring a proper fit, both in its groove and in the cylinder. After being split the ring should be closed and then turned to fit the bushing for which it is designed. Where this is not done the rings should be eased off with a file until they bear evenly all around the cylinder walls. Cents spent for this work will save dollars in fuel consumption.

The practice at the Allston shops of the Boston & Albany is to bore the 12-in. bushings twice, 12 3/32 in. and 12 3/16 in., respectively, before they are replaced by a new bushing. Where this practice is followed and the packing rings are expanded in the same ratio without expanding the followers of the piston valve rings, trouble is experienced in the following two ways: the ring projecting into its groove 3/32 in. less all the way around in case of the 12 3/16 in. bore has less bearing in the groove and there is a greater chance for leakage of steam to occur laterally. The other trouble is the ring is liable to hang down so as to catch in the bushing and not go into the counterbore. For instance, given a 1/16 in. clearance around the follower and 1/8 in. spring in the ring in case of 12-in. bushing the ring hangs down below the riding ring 3/16 in. After the bushing is increased 3/16 in. in diameter the ring hangs 3/8 in. below riding ring. The idea to be brought out here is to have the ring sizes the same bore for 12 in.—12 3/32 in.—12 3/16 in. valve bushing making their depth of fit into the grooves constant and to increase their diameter by making the overlapping leg of the L thicker, *i. e.*, no other dimension of the ring should be changed except the outside diameter of the rings and riding rings.

This would be of great benefit to men in engine house repairs, as many times the counterbore is small on the start and is never increased when bushings are bored. If you ever experienced the trouble of getting valves in on a hot summer day with a leaky throttle when the time is short you would know what this means.

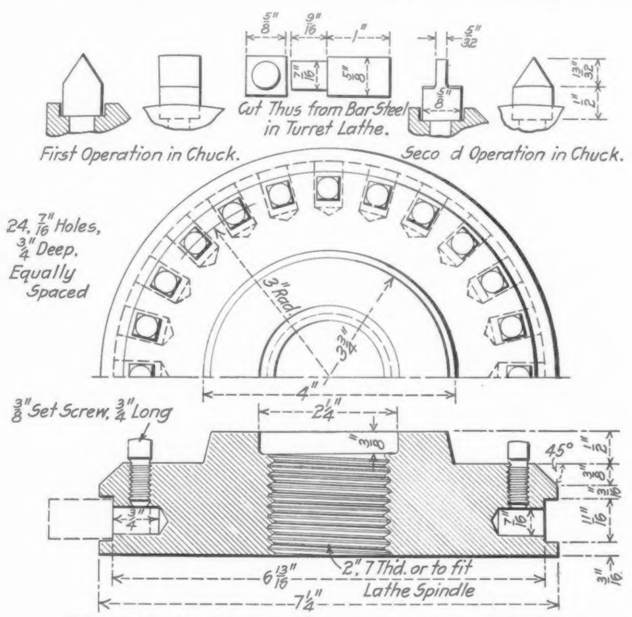
* Entered in the Piston Valve Packing Ring Competition which closed October 1, 1915.

CHUCK FOR THE MANUFACTURE OF FLUE CUTTER BLADES

BY E. A. MURRAY

Master Mechanic, Chesapeake & Ohio, Clifton, Forge, Virginia

The illustration shows a device which has been employed very successfully at the Clifton Forge Shops of the Chesapeake & Ohio in the manufacture of flue cutter blades. Until a few years ago it was the practice, to buy flue cutter blades, but these blades gave very poor service due to breakage. It was finally decided to make the cutters in the shops, and a saving of nine



Chuck for the Manufacture of Flue Cutter Blades

cents on each cutter has resulted with an increase of over 200 per cent in efficiency. The chuck was designed by W. C. Diebert, tool room foreman.

The cutter is made from a 5/8-in. square bar of high speed steel, which is turned and cut off in a turret lathe, as shown at the top of the illustration. These parts are then placed in the recesses in the rim of the chuck, where they are secured with set screws. The machining is done in two operations, the cutters each being revolved through an angle of 90 deg. in the recesses, after the first operation is completed. The chuck has a capacity of twenty-four cutters.

THE SELECTION OF MACHINE TOOLS

Each Tool Must Be Studied Critically and Scientifically in Order to Secure Greatest Efficiency

BY GEORGE W. ARMSTRONG

The output of a shop and the economy effected in its operation depend primarily on the capacity of its machine tools. Coordinately the capacity hinges on the care exercised before a machine is purchased in ascertaining the character and amount of work which it is expected to perform, and the relation which its design factors bear in fitting it for the work intended. Simplicity is the prime factor and the other essential requirements are rigidity and accuracy.

The purchase of any machine tool should only be the result of a thorough canvass and analysis of its desirability and utility. Too often, the question of new equipment is determined from recommendations made by master mechanics, shop superintendents, etc. While it is desirable that the local supervision should be consulted in matters pertaining to their shop operations these recommendations are often apt to be colored by the desire to have facilities equal to that of the "other fellow"; by the desire to be well fortified with equipment to obviate possibility of falling down on shop output with its consequent trouble; or often because of the zealous importunings of machine tool salesmen.

The selection of suitable machine tools should involve not only a consideration of the initial cost, but also of its cost of operation and the design factors influencing the repairs and maintenance. Operating conditions will largely determine the size and type of machine, but where possible no machine tool should be selected unless sufficient work can be provided to keep it in continuous operation.

COST OF MACHINE TOOL OPERATION

Interest on investment, including cost of machine tool, accessories and installation.

Depreciation on investment.

Cost of maintenance.

Power cost.

Wages of operative.

Proportion, based on floor space requirements, of the plant overhead, consisting of interest, taxes, maintenance, insurance, etc., on building.

Proportion of the supervisory and clerical cost.

It can readily be seen from the above factors that the hourly charge for a machine tool can be approximately as great whether the machine is idle or producing. Nor are these charges by any means imaginary, but rather tangible items entering into an actual cost appearing yearly in the accounts, and for which provisions are made in the Uniform Classification of Operating Expenses prescribed by the Interstate Commerce Commission.

The necessity will thus be recognized for selecting a machine tool which will be continuously operated and one requiring a minimum time for making speed and feed changes, and equipped with rapid set-up facilities. It is the desirability for maximum productive operation that recommends motor drive, gear box speed changes, push button control, the use of a vertical turret lathe or boring mill in preference to an engine lathe, or a horizontal milling machine in certain instances in preference to a planer.

Where the proposed machine tool installation is to be a replacement, the tool selected must be able to justify its existence; in other words, it must be able to show an earning or saving in the cost of operation based on the productive output as against the cost with the tools already in operation. As will be seen by consulting the table given above for cost of machine tool operation, this involves more than the labor costs. Frequently it would be possible to employ a tool of such size and capacity as to effect a 50 per cent, or even greater saving in labor cost, but it would nevertheless be a very questionable economy; in fact, even an increased expense owing to lack of sufficient work to fully utilize the tool's capacity, or due to the extremely high fixed expense. For example, in a shop with an output of about 10 engines a month, having an 80-in. driving wheel lathe on which the cost of turning a pair of wheels was $1.40, it would be a sheer waste to purchase a 90-in. motor-driven machine which could do the work for 50 cents a pair.

An expenditure, on the other hand, for a modern high duty radial drill press capable of effectively utilizing high speed drills would undoubtedly be fully warranted, as by its means a productivity of sufficient magnitude could be secured to replace two or more old-style machines. Yet this might still be unwarranted if the old machines are of ample construction and capable of being strengthened in feed mechanism and gear drive so as to utilize the capacity of high-speed steel.

In an initial installation, the prime influence of course is the necessity for certain machines to adequately cope with the work contemplated. The type of machine and the degree of development, other than that imposed by the work, should be the result of a careful analysis of the various characteristics (as outlined in the table of factors for consideration in machine tool operation) of the machine tools available. As far as possible, this analysis should be based on the manufacturer's specifications, supplemented by an actual observation of the machine tool in question under working conditions.

Cost Factors.	Investment	Initial cost of machine. Cost of accessories. Installation. Depreciation.
	Maintenance	
	Operational	Hourly charge when idle. Hourly charge when running. Normal production per hour. Unit cost of production.
Design Factors.	Materials of Construction	Kind and quality used for different parts. Distribution of metal. Strength and stability of design.
	Power Drive	Belt, geared, motor or chain? Is the power ample? Is it positive or flexible, and which is best suited? Is control centralized and easily accessible? Are heavy parts power moved? Is mounting provided for direct motor drive?
	Speeds and Feeds	Are speed changes ample? Do they fit scheme of uniformity adopted for your shops? Are they in geometric progression? Can changes be quickly made?
	Bearings	Ordinary. Ball bearing. Roller bearing. Provision for taking up wear in major bearing.
	Lubrication	Forced? Sight feeds used? If not forced, are oil holes accessible? Oil or grease cups on bearings? Gears enclosed? Run in oil baths?
	Method of Chucking Work	Ordinary. Magnetic. Air controlled.
	Safety Provisions	For the operator. Of machine, i. e., foolproof safeguards.
	Operation	Frictional loss. Absence of vibration. Ease of feeding and discharging. Convenience of attachments.
	Repairs	Are wearing parts interchangeable, accessible and easily changed?
	Miscellaneous	Facility for quick set-up. Range of work possible. Is it easily movable? Arranged for use of cutting lubricants? Compact, yet not crowded? Fit location available?

In general the selection of a machine tool will resolve itself

into one of the following types as being those most commonly required in railroad practice:

1, Bolt threading machines.
2, Boring machines.
  a, horizontal.
  b, vertical.
3, Drilling machines.
  a, heavy duty box-column type.
  b, radial.
  c, vertical.
  d, sensitive.
4, Grinding machine.
  a, cylindrical.
  b, cutter and tool.
  c, disc.
  d, drill.
  e, floor and bench.
  f, internal.
  g, surface.
5, Lathe.
  a, engine or plain.
  b, turret.
  c, special, as wheel, etc.
6, Milling machine.
  a, horizontal.
  b, vertical.
  c, universal.
7, Planing machine.
8, Shaping machine.
9, Slotting machine.

Brief consideration will be given the various types, their advantages and respective merits.

CONSIDERATION OF DIFFERENT TYPES

Two general types of bolt threading machines are in service, differing mainly in details of construction imposed by use of high speed and carbon steel dies. While the use of high speed steel must not be depreciated, as we owe to it our modern development of machine shop practice, it is questionable as to the advisability of employing it where any style of thread cutting tool is required. A full realization of the high speed elements in steel require tempering at approximately 2,200 deg. F. As this brings the steel almost to a state of fusion, it will be seen that if attained the points of the threads must be injured. To avoid this, a temperature of about 1,700 deg. to 1,800 deg. F. must be used, which renders it but little more effective than well tempered carbon steel. Particular attention should be paid in the threading machine to the construction of the die head, as the locking mechanism holding the dies in place while cutting, is of the utmost importance in securing an accurate, clean cut job.

Both types of boring mills are useful shop tools. The utility of a horizontal boring machine will be readily apparent for all classes of work requiring only boring and facing with no external turning, as it is capable of performing the work more effectively and quicker than an engine lathe or vertical machine.

Where work of any size requiring chucking is to be turned it is doubtful if any more effective machine can be selected than a vertical turret lathe or boring mill. With it quick set-ups can be secured, maximum rigidity of setting, quick tool changes and good cutting speeds. Particular attention should be given in boring machine selection to the manner of driving. Worm gear drive should be avoided, not only for these but for all types of machines, as it gives considerable trouble because of overheated and cut bearings and wears rapidly. Spur gear driven machines will be found far more satisfactory. A table, so constructed that it will not have a tendency to lift up with heavy cuts, is also to be desired.

All the types of drilling machines are to be found in railroad shops, the sensitive drill mainly only in tool rooms. By far the most satisfactory all-around machine is the high duty radial drill. This should be of rigid construction and with an arm so braced as to avoid springing under heavy feeds. This latter results in the drill dropping when emerging from the hole and is the cause of many broken drills. Variable speed motors are preferable in securing speed changes to a machine with either motor or belt drive and gear box changes.

Grinding machines are in service, but owing to their often complicated construction and limited use, it is doubtful whether other than for various tool grinding purposes their selection is justified.

Regarding the lathe, it is often debatable whether to purchase a plain engine lathe or some type of turret lathe. Usually a powerful standard machine provided with quick speed and feed changes will turn out more work cheaper than an automatic or semi-automatic because:

1. The average machine job having few operations on it, rarely brings the special features of the semi-automatic into play.
2. In general, the number of pieces to be run through are too few to pay to set the stops, etc.
3. The machines are seldom properly equipped because each new job generally requires a complete outfit of special tools.
4. On account of these machines being more complicated than the average standard tools, some part is often out of order—not badly enough to pay for overhauling, but enough to interfere with the running.

Where work is to be done which is easily swung on centers an engine lathe is best adapted; while, as previously stated, the vertical turret lathe or boring mill is best adapted for all chucking work other than very small pieces.

The milling machine is a rapid producer as, owing to the greater area of cutter surface, higher speeds can be employed, cutting speeds of 70 to 90 feet per minute being not unusual. The horizontal milling machine also possesses the advantage that one piece can be machined while chucking or setting another, thus making the machining practically continuous. The horizontal machine is the ideal machine for heavy, fast cutting, as the strain comes straight down on the table. The vertical machine is best adapted to small and flat work. If the surface milled stands high above the table, the horizontal pressure of the cut throws a heavy strain on the chucking fixtures or clamping down bolts. High work also tends to lift the table from its bed and thus produces chatter. With the milling machine, particular attention should be paid to the size of the spindle, which should be at least one-third the diameter of the cutter head which it is desired to use. A substantial, rigid spindle is the most important factor in successful milling machine operation, as with a head and spindle that springs the feed will be only about one-quarter to one-fifth of that otherwise maintainable.

The planer, shaper and slotter are all so well known that little need be said regarding them. Owing to the variety and range of material, from chrome and vanadium steels to steel castings. and from cast iron to brass, a fertile field has been opened for variable speed motor-driven planers, of which there are several good ones available. Worm gear driven machines are to be avoided for the same reason as cited in connection with boring machines. As it is detrimental to maintenance of accurate surfacing to operate a planer to any considerable extent on short stroke, the class of work should receive serious consideration in the determination of the proper size.

GENERAL SUGGESTIONS

In conclusion, a few suggestions applicable to machine tools in general are given.

Lubrication should be well taken care of and be positive in cases of heavy machines. All high speed bearings should be equipped with ring type oilers.

The bearings, especially main, or others having considerable wear, should preferably be of a split type to facilitate taking up wear gradually. Certain types of tapered sleeve bushings are also useful, but do not permit of the latitude afforded by the split bushing.

Wherever possible avoid anything but spur gear driving and if necessary in high power transmission use heat treated gears. Avoid bevel gear drives as a source of constant trouble if you would have peace of mind regarding your machine.

For some heavy machines gears having teeth cut at an angle are to be recommended, as this prevents chatter and marking of works by the gear teeth. The power should pass through as few gears as possible from motor or belt cone to the work, and no gear should be required to run higher than 1,000 ft. per min.

of tooth speed. Above this, it is best to use belts or silent chain drive.

Machines equipped with bolt slots should have them designed so that the depth of the narrow part is at least 30 per cent greater than the width of the slot to prevent breaking of slots. It is important, too, that in service only bolts be used having specially machined heads so as to fully fill the slot.

And last, it should be borne in mind that the most salient points in machine tool selection are simplicity, accessibility, rigidity and accuracy and that the limiting factor in output should either be the tool or the strength of the piece machined after it has been set up to resist a heavy cut.

OIL CANS OF RATIONAL DESIGN

Just why certain peculiar forms of oil cans are used by railroads is a question, when we consider the severe service to which they are subjected. Like many other things it is possibly due to lack of study and consideration on the part of those in charge of this work, or in the blind following of precedent. Some of the peculiar shapes in which they are made and the damage to which they are subjected is clearly shown in one of the photographs.

An Oil Can Designed to Withstand Severe Service

The second photograph shows a new design which was introduced on the St. Louis & San Francisco a couple of years ago and has given excellent service. The cars shown are of 5 and 10 gal. capacity, made of No. 16 galvanized iron. These cans are made with flat tops and bottoms, flanged in ¾ in. and riveted with rivets on 1¼ in. centers. They are soldered in a large pot of melted solder, so that every rivet and seam is soldered at one time. The cans will stand a pressure of 40 lb. of air per sq. in. in testing them for leaks.

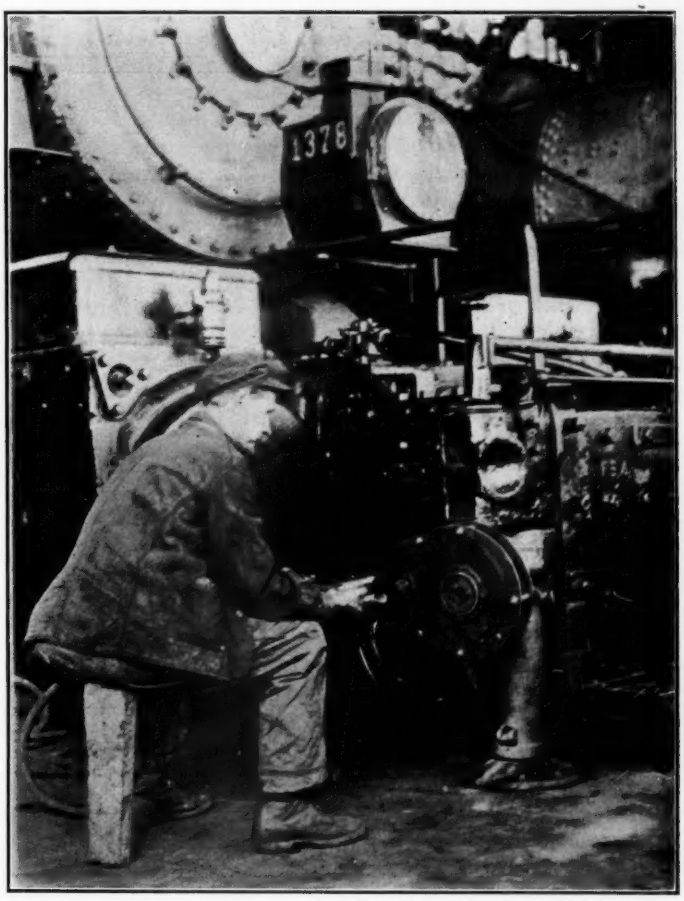
Poorly Designed Oil Cans Which Are Easily Injured and Require Considerable Storage Space

The 5-gal. cans cost $1.65 and the 10-gal. cans $2.00. The cans may be rolled out of a car in unloading and not be damaged; in storing in the store department they will not take nearly as much floor space as other cans do. They will last indefinitely. The 5-gal. cans that were formerly used were made of No. 26 galvanized iron. They cost $1.10 and the 10-gal. cans cost $1.35; and they would not last more than about two or three months.

POWER OPERATION OF RATCHET JACKS

BY ALLEN RAYMOND
Assistant Roundhouse Foreman, New York Central, Avis, Pa.

Raising an engine or tank with ratchet jacks is at best a slow and tedious operation. The workman is compelled to use up his energy in getting the engine off the rails and when he is ready to do the work for which the raising of the locomotive is but the preparation, he is tired out. The quality of the repair work done is therefore apt to suffer. The illustration shows a means by which this condition is reversed, the jacks being operated by an air motor which eliminates the heavy exertion from the raising of the engine.



Operating a Motor Jack with an Air Motor

The device consists of a simple double train of gears. The shafts of these gears are supported in a casing made up of two plates which may be maintained in proper relation to each other either by special bolts or straight bolts with thimble spreaders. The shaft of the small gear ends in a Morse No. 4 taper shank, to which any reversible air motor may be attached. The jack is operated from the shaft of the large gear, which is provided with a hexagonal socket. A ⅞-in. eye-bolt is pivoted on one of the casing bolts at the motor end of the device. This bolt is 26 in. long and supports the device against the reaction from the motor torque.

With an air motor, using one of these reducing trains, a Norton ratchet jack may be operated about three times as fast as any

two men can operate it and it will lift a load that three men can only move with difficulty, using a 4-ft. jack handle. In addition to the ease with which heavy loads may be handled, this device facilitates operation in cramped positions where it is almost impossible to operate a jack by hand. No additional weight is added to the jacks to increase the difficulty of moving them into place as the gear trains are slipped on after the jacks are set.

Two of these gear trains are all that are needed, as they may readily be moved from one job to another. No expenditure other than the cost of the gears is required, as the devices may be used with old jacks.

HELP THE APPRENTICE TO HELP HIMSELF*

BY FRANK J. BORER
Foreman Air Brake Department, Central Railroad of New Jersey, Elizabethport, N. J.

My answer to your question, "How can I help the apprentice boys?" is, By helping them to help themselves.

Assume that I am an apprentice on the A. B. C. R. R. I want to become a skilled mechanic and if possible a foreman, or even a master mechanic. To attain my goal I must put myself in shape to be worthy of the efforts of my instructors and foreman. I must think more of my work than I do of baseball, the movies and other diversions. I must come to the shop with an enthusiasm and ambition to learn and to work. I must concentrate my mind to obtain knowledge, since knowledge is power and ignorance impotence. To be a good apprentice I find it is necessary to have a fairly good education—the more the better.

Having the proper qualifications my future progress as an apprentice depends almost entirely on the effort the company makes in my behalf.

I consider it of the utmost importance that we be given regular classroom instructions in drawing and arithmetic and special or individual instruction relative to the particular class of work we are performing in the shop. For instance, if we are apprentices in the locomotive erecting shop we should be given instructions in valve motion, and apprentices in the car department should receive instructions in the M. C. B. rules and safety appliances. To assure a standard of method and regularity, a special instructor working in co-operation with the foreman should have charge. We apprentices should then be subject to a thorough system of checking and examination to ascertain our progress, characteristics, special traits or talent, deficiencies, etc.

To obtain the best results our instructors should have a keen insight into human nature. They should appeal to our self-interest to create a healthful rivalry between us to excel one another and promote us according to merit. This will act as an incentive to put forth our best efforts. While some of us have executive ability and crave for responsibility, others shirk it, but have genius or initiative in its stead. We all strive, however, for one common object—a well-paid, steady position according to our ability.

The mutuality of interests between us and the company should express itself in our work. On the other hand, the foreman should always treat us kindly but firmly. He should never swear at us. Neither should he expect too much of us at the beginning. If he puts us to work with a mechanic, he should pick out a good man and not a John Barleycorn or Jack Good-enough. He should look at the apprenticeship system from an altruistic as well as an investment-business point of view; something that will bring large returns if properly handled. If the foreman succeeds in building up a force of good, loyal young mechanics as the years roll by, he has rendered the country at large as great a service as its best teachers, artists and the professional men.

* Entered in the competition on "How Can I Help the Apprentice?" which closed September 1, 1915.

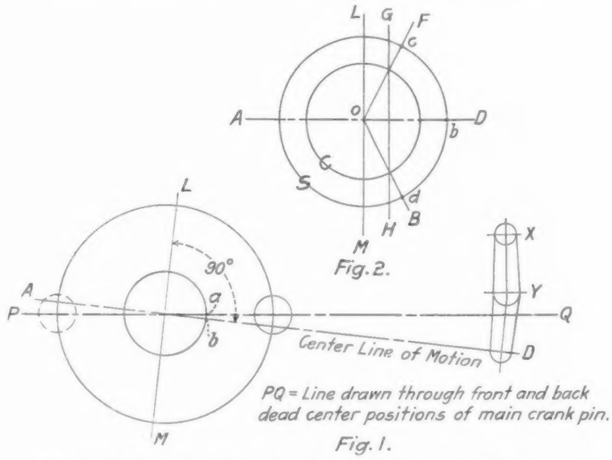
LAYING OUT ECCENTRIC KEYWAYS

BY R. S. MOUNCE

It is generally considered impossible accurately to lay out eccentric keyways in Stephenson link motion, it usually being necessary to properly adjust the eccentrics by means of offset keys. But by following the method here set forth the writer has found it possible to use at least three straight keys with the fourth not more than 1/32 in. out of true. It should be noted, however, that these results can only be obtained by great care in securing an accurate layout.

The center line of the valve motion in relation to the crank pin must first be determined. This can usually be determined from the general drawing of the locomotive and should be laid out to half-size or full-size scale, as shown in Fig. 1. Lay out point *a* on the main axle with a box square and from *a* lay off the distance *ab* with a pair of dividers. Then draw a line half way across the axle through the point *b*. This is the line from which the eccentric keyways are to be laid off. In a similar manner draw a corresponding line on the opposite half of the axle.

Assuming a slide valve, and that both arms of the rocker are of the same length, *AD* in Fig. 2 represents the center line of



An Accurate Method of Laying Out Eccentric Keyways

the motion. *LM* is drawn perpendicular to *AD*. Draw *GH* parallel to *LM* at a distance from it equal to one-half the total outside lap of the valve, plus the lead. Draw the circle *C* with a diameter equal to the throw of the eccentric, and the circle *S* with a diameter equal to the eccentric bearing on the main axle. Draw the lines *OF* and *OB* intersecting *GH* on the circle *C*. The points *c* and *d*, where these lines intersect the circle *S*, indicate the location of the centers of the eccentric keyways on the axle and should be laid off from the line drawn on the axle through the point *b*, with dividers set for the distance *bc* and *bd*, which are equal.

If the arms of the rocker are of unequal length, the distance between the lines *GH* and *KL* will be the lap plus the lead multiplied by the ratio of the lower arm to upper arm.

FRENCH FUEL BINDER.—A fuel binder recently patented by a French maker, which is fusible to a vitreous mass at 200 deg. Cent., consists of 15 parts of glassmaker's sand, 18 parts of Portland cement, and 10 parts of carbonate of soda or other flux for silica, such as sea salt or sulphate of soda. Dry fuel dust, such as coal in grains up to 5 mm. in size, is mixed with from 4 to 6 per cent of the mixed binding ingredients, the product, with the addition of 8 per cent of water, being compounded in a mixer to which steam under 8 kilos. pressure, at 170 deg. Cent., is admitted, the mass subsequently being pressed into briquettes. Heat may be applied to the material issuing from the press to increase the cohesion.— *Engineer (London)*.

BETTER LOCOMOTIVE BOILER INSPECTION

Five of the Articles That Were Submitted in the Competition* Which Closed November 1, 1915

BY W. H. SAGSTETTER
Master Mechanic, Kansas City Southern, Shreveport, La.

One of the most annoying incidents in the mechanical department is the tying up of a locomotive by a federal boiler inspector. This can be easily overcome by an efficient and proper organization. Each railroad and each division thereon must have a system of boiler inspection that fully complies with the federal law and is at the same time efficient.

The first and most essential thing is to have a practical boiler inspector, one who has plenty of good common sense, and who is thoroughly familiar with all rules governing the inspection and maintenance of locomotive boilers and their appurtenances.

The boiler inspector must be able to operate and inspect all appliances that come under the regulations and to see that they comply strictly with such regulations; he must be able to make proper and intelligent reports, and his ability must be such as to leave no doubt in the minds of his superior officers that the reports are accurate; he must not be easily swayed by minor officers, or even by his superior officers, and must assume no responsibility that he would not assume were he in their place; he must be invested with the same power as a federal inspector and his reports should be given the same consideration as those of the federal inspector; he should at all times have access to all records, so that he may keep posted as to the requirements of each individual locomotive on his division and should, further, have his own file of boiler inspection reports for ready reference.

To have an inspector who is not familiar with the rules is as bad as having none at all. A competent man must be able to make a hammer test of staybolts, to examine fire sheets for cracks, to measure the depth of a telltale hole and to operate gage cocks, injectors and water glass cocks. He should also be able to ascertain whether or not a pop is properly regulated and to see that all boiler forms are properly filled out according to instructions. The inspector should have no hesitancy in calling the attention of the various foremen, or the master mechanic, to a defective boiler or its appurtenances and should insist on such parts being repaired before he signs the reports in the presence of the notary public.

The foremen at division points are too prone to neglect small things that conflict with the laws, and that should be repaired before engines are allowed to depart from the terminals, and unless the boiler inspectors are very strict they will be persuaded to allow engines to make one or more trips before such work is taken care of—and in all probability, within one or two trips, the engine will cause an accident or be found in defective condition by the federal inspector.

The old adage, "A stitch in time saves nine," has proved to be very true as applied to boilers. It will be found that if a staybolt is removed as soon as it is found broken, instead of allowing it to run, probably causing the breakage of adjacent bolts, time will be saved in the end. Where one bolt can be renewed in one hour it is ofttimes necessary to hold an engine for a day to renew six or eight.

The co-operation of the master mechanic and division foreman with the boiler inspector is essential, and on the first day of each month the chief clerk of the master mechanic should send out to the boiler inspector, and all division foremen, a statement giving a list of locomotives that are due to receive attention during the month, as to hydrostatic test, removal of caps from flexible bolts, etc. Opposite the engine number should be shown the date on which such work is due; this information gives the roundhouse foreman an opportunity to arrange for such heavy repair work as may be necessary on the engine at the time the boiler work is done.

The form illustrates a complete five-year record of a locomotive. This record should be kept in the office of the master mechanic so that correct information can be furnished relative

Inspection Form No. Form M. P. 187

The Kansas City Southern Railway Co.

Locomotive: Number 491; Initial KCS

	July	August	September	October	November	December	January	February	March	April	May	June
1911-12	28	18	19	14	9	29	23	20	31	16	20	19
1912-13	20	20	30	29	27	20	31	7	31	5	3	18
1913-14	18	23	29	2	20	25	27	25	23	25	30	20
1914-15	15	31	5	9	30	21	8	8	11	16	15	5
1915-16	7	12										

Hydrostatic Test Period—One Year	Flexible Stay Bolt Caps Removed Period—18 Months	Flues Removed Period—Three Years	Lagging Removed Period—Five Years
Apr. 16th., 1912	Apr. 5th., 1913	Apr. 16th., 1912	April, 5th., 1913
Apr. 5th., 1913	Oct. 9th., 1914	Apr. 5th., 1913	Dec. 21st., 1914
Mar. 23rd., 1914	Dec. 21st., 1914	Dec. 21st., 1914	
Dec. 21st., 1914			

Remarks: New Firebox applied Dec. 21st., 1914.
All new flexibles applied Dec. 21st., 1914.

Underscored figures are red in original and indicate date of hydrostatic test

Five-Year Record of Locomotive Boiler Inspection

to hydrostatic test, etc., and should at all times be open to the boiler inspector, boiler shop foreman, and others concerned. The date of the hydrostatic test should be inserted in red,* and the remainder of the information in black ink; by so doing the date of last test is easily ascertained.

I believe that if the shop boiler inspector is allowed the same authority as the federal inspector, especially as to condemning a boiler when it does not come within the requirements of the law, and such rule is enforced, there will be more effort made by the roundhouse forces to see that all small defects are taken care of as soon as reported, thus avoiding criticism by the government inspectors.

BY FRED CHINNOCK
Boiler Inspector, Grand Rapids & Indiana, Grand Rapids, Mich.

A locomotive boiler inspector should be a practical boiler maker, thoroughly familiar with the construction, repairing and operation of locomotive boilers. He should be able to find the safe working pressure of a boiler in all its details and determine as to whether or not it is in a safe condition to carry the load under which it operates. He should also be familiar with the federal laws covering locomotive boilers and their appurtenances.

Filing cabinets, desk room and stationery should be furnished for filing copies of the federal reports and keeping records of washouts, steam gage tests, hydrostatic tests, flexible staybolt examinations, etc.

In making an inspection of a locomotive boiler, the firebox should be examined for broken staybolts and crown stays, defective flues and arch tubes, laminations, mud blisters, cracks and leaks. The outside should be examined for leaks, broken staybolts, defective washout plugs and defective arch tubes. The

* The prize article and one other were published in the December, 1915, issue, page 635. The annual report of the Chief Inspector of Locomotive Boilers to the Interstate Commerce Commission was published in abstract in our January issue, page 41.

* The underscored figures in the illustration were in red ink.

boiler should be properly washed, and the gage and water glass cocks and arch tubes cleaned. The steam gage test, hydrostatic test, or flexible staybolt examination, should be made at this time, if due during the month. All defects should be repaired and proper reports filed with the district inspector. Should a hydrostatic test be necessary an internal inspection should also be made.

A boiler inspector should not be overburdened with such work as inspecting ash pans, grates, nettings, front ends and other locomotive running repairs. The federal law should be amended so as to require flexible crown stays, or stays made of hollow iron, to be used in wagon top boilers, as it is impossible to detect all the defective crown stays with a hammer test in boilers of this type.

BY R. S. LEE

General Foreman, Stroudsburg, Pa., Shops, New York, Susquehanna & Western

A boiler inspector should have a fair education to enable him to keep his records in proper condition; read blue prints, and make out certificates and reports. He must be alert, observing, temperate, have a good memory, an even disposition, and a personality that will command respect.

After a boiler has jacket, lagging, flues, etc., removed and is thoroughly scaled and cleaned, he should make a thorough inspection, carefully noting any evidence of cracks, pitting, grooving, corrosion, and deposits of scale on crown sheets. All braces and stays should be examined to see that they are under proper strain, are of right dimensions, free from cracks and sufficient in number. All staybolts should be tested, and all evidence of steam or water leaks noted and taken up with proper officer. After his report is made he should check up to see that his recommendations are acted upon and the work properly done; to do this he must receive the support of every supervising officer. He must be familiar with all the requirements and in all cases his authority must be respected.

In order to facilitate his work he should be provided with a desk and filing boxes in the office of the foreman boilermaker so that any matters between them may be handled with despatch. Where electricity is used a small electric lamp designed to be inserted in washout holes is of great value in examining the crown sheet, front and back ends of mud ring, etc. This light should be located at the end of a piece of ⅜-in. pipe, which serves as a handle and covering for the wire, and should be long enough to reach from the back head to the front of the crown sheet; the bulb should be protected by a shield at the end.

BY A. MacCORKINDALE

Foreman, Meadows Shops, Pennsylvania Railroad, Jersey City, N. J.

It is a matter of close supervision by the motive power departments to see that all tools are in first-class shape; also all boiler work done must be reported and immediately filed so that every engine may be checked in every detail of boiler inspection. Copies should also be filed in every division roundhouse to which the engine is assigned. Our experience has shown this to be very valuable where a certificate happened to be lost out of the cab, or a boilerwash or staybolt tag gone. A telephone message to the division roundhouse night or day from other division or interdivisional points, such as Philadelphia, Washington or Harrisburg, concerning boiler inspection, brings the necessary data and no delay is ever caused on that account. This filing system is always under the eye of the boiler inspector.

May we offer the following advice: "Follow instructions;" "Assure yourself that everything is as ordered before taking an affidavit;" "Don't forget that the reputation of the corporation you work for is shared with you and if the unforeseen failure happens involving legal proceedings the evidence of the boiler inspector looms high."

BY T. E. TOOHEY

Boiler Foreman, Union Pacific, Evanston, Wyo.

On the last of each month we make out a form, listing locomotives in numerical order, and showing each individual engine under our care for the next month. It shows which are due for test of safety valves and steam gages, change of flues, hydrostatic test, caps to be removed from flexible staybolts, etc. This is put in a convenient place, so that the boiler foreman and boiler inspector may have access to it at all times. Each morning it is studied to see what is to be done in the next 24 hours.

In addition to this we have a form listing engines in numerical order; when inspection is made and report is filed, we mark date that inspection report was filed opposite engine number. By so doing, we always have at hand data as to what inspections have been made, and date that inspections were made. We never duplicate any reports, thus causing unnecessary work.

The boiler foreman has a special book which shows for every engine under his care, the date the firebox was applied, date of last hydrostatic test, date safety valves and steam gages were tested and pops set, date caps were removed from flexible staybolts, date flues were last changed, months engine was out of service (if any) to take advantage of the automatic extension we are entitled for hydrostatic test, removal of flues, etc.

As regards monthly I. C. C. boiler inspection reports, Form No. 1, and annual I. C. C. boiler inspection reports, Form No. 3, we have a separate file for each in a convenient place. When inspections are made and the forms are made out a copy is placed on file and the copy for the previous month or year is removed and filed for future reference.

After the boiler inspector has made all necessary inspections, and has seen that all defects he has reported have been repaired, he makes out his monthly I. C. C. Form No. 1, or the annual I. C. C. boiler Form No. 3, as the case may be. The forms are then placed on the boiler foreman's desk, who checks against them from his special book, and from the previous month's or year's report, which is on file. Any mistakes he finds are corrected and the forms are forwarded to headquarters at Omaha.

We have plenty of office room and desk room and our superior officers are always willing to give us any facilities we may ask for that will help in any way to make our work more effective.

DETAILS OF INSPECTION

Each morning the boiler inspector receives from the boiler foreman a list of locomotive boilers to be washed out during the next 24 hours. If any of the boilers on this list are due for an inspection, he makes it after the boiler is blown off, inspecting all firebox sheets, flues, testing staybolts, etc. If he finds any defects, he reports them immediately to the boiler foreman. He then sees that necessary repairs are made. If the engine is due for test of steam gage, and the safety valves are to be set, this work is done.

If the engine is due for hydrostatic test, we remove the pops and place caps over the pop holes, also putting a gage on the turret dome, in addition to the regular boiler gage. We have the lagging and jacket removed from over the staybolts, and use a La Rue ejector for getting the required pressure on the boiler. The steam gages are tested before applying pressure to the boiler. The dome cap and throttle box are removed after the test, and the interior of the boiler is inspected above the flues. If any defects are found while testing the boiler, such as leaks in any part, broken stay bolts, etc., the necessary repairs are made before the engine goes into service.

In addition the boiler inspector examines telltale holes in staybolts in all engines in the roundhouse each day to see that they are open and of the required depth. He also examines for steam leaks and other defects that may show up while the engine is under steam pressure.

The boiler foreman has a form to keep records of boilers washed; the engines are shown in numerical order, and each morning he lists those that have had their boilers washed out during the preceding 24 hours. After the boiler is washed out it is examined through the washout plug holes to see that no mud or scale is left inside. All washout plugs are inspected, as well

as threads in washout plug holes, to see that they are in good condition.

When any broken staybolts are renewed the exact location is marked on a Union Pacific staybolt chart, and at the end of the month they are reported on separate charts for each engine. In addition all patches applied, flues changed, plugs applied to cracks in firebox, new cracks developed in sheets, etc., as well as estimated life of firebox, and condition of flues, are reported on this staybolt chart.

In addition the boiler foreman is also on the job looking for defects in locomotive boilers under his care. He also has a standing order to boilermakers doing running work, both day and night, to report to him any defects that may be found. We find by doing the jobs as soon as possible and keeping our work up, we get the very best results, and our power is always in good condition.

At Evanston we are always glad to have government boiler inspectors visit us, and inspect our boilers. They always have some good suggestions as to the way boiler work is done at other places and are willing to give us these ideas. We are also glad to furnish them any new kinks or schemes that we may have.

TONING UP AN ORGANIZATION

The three prize-winning letters submitted in the contest to secure practical suggestions for "Toning Up an Organization" are given below. This contest closed January 1, 1916.

EFFICIENCY MEETINGS

BY J. A. PACK

Chief Clerk, Motive Power Department, Chesapeake & Ohio, Huntington, W. Va., Shops

It has been the practice at Huntington shops for several years to call the foremen of the different departments together in semi-monthly efficiency meetings, a regular organization being effected with a chairman and secretary. At these meetings the progress of the work and suggestions for the improvement of methods and working conditions are freely discussed. This results in better coöperation and team-work.

The shop superintendent and general foremen are able to smooth out differences and misunderstandings which occasionally arise, bringing all together in a general discussion and harmonizing the entire force. By having these efficiency meetings at certain periods, the shop superintendent and the foremen become well acquainted with each other in a way that cannot be done when they merely meet in the ordinary course of their duties, one or two at a time. Here they gain an insight into each other's mentality and sympathy. It is conceded that mind is the source of all action, that loss in efficiency is the result of wrong thinking, and such loss can be corrected by establishing a system that will tend to eliminate wrong thinking. The wrong thinker is the wrong doer and a wrong act is always produced by a wrong thought. Many think incorrectly and are so self-satisfied that they believe they are correct. It should be remembered that faith in your fellow men is requisite to co-operation, and that the spirit of driving has long since ceased to be a virtue.

The chairman of the efficiency meetings always endeavors to teach that all operations correctly performed are based on right thinking. No man can think correctly and have a clear mentality unless a great effort is put forth to eliminate from his consciousness self-satisfaction, self-esteem, envy, hatred, anger, jealousy, resentment and fear. As coöperation between the foremen, and also between the foremen and men is an absolute necessity, it would be well for each foreman to thoroughly understand how coöperation can be secured and maintained.

The foreman should always be ready and willing to listen to suggestions made by his men and encourage suggestions, as the entire plant is made up of mental force, and by soliciting suggestions from the men he will have coöperation; whereas, on the other hand, by rebuking an employee or failing to listen to his suggestions, a resentment is set up. This, being opposed to right thinking, cannot result in a harmonious organization.

ENCOURAGE SUGGESTIONS FROM THE MEN

BY JOHN V. LE COMPTE

Foreman, Motive Power Department, Baltimore & Ohio, Baltimore, Md.

A perfect organization should have at its head a man of discretion and knowledge, a man with ability and personality, a man whose orders must be carried out and who is a natural born leader. The results, as well as the success of the organization, depend largely on the head and his assistants. Although the personnel of the organization may be the best that can be secured, the good results which might obtain can be neutralized by improper leadership.

The success of this organization depends largely on harmony, backed by the spirit to accomplish effective results. This harmony can be and has been intensified by bringing in contact on a business basis the foremen and assistants of the various departments. Meetings of this character have been conducted with favorable results, thus bringing in contact men whose experience has been broadened by holding supervising positions.

The spirit of Ego should not characterize the head of the staff or his assistants in these deliberations for the good of the service, but rather the spirit of "we are one of you."

Meetings of the staff can be almost non-productive because of the above spirit being evident, and a throttle thereby put on an otherwise free discussion of means and methods, which no doubt could produce results.

What the staff is to the organization as a whole, the shop meeting can be to each department. Each foreman, assistant, gang leader, apprentice instructor, piece work inspector and clerk, together with each employee, should be made to feel that he is a vital part in the organization by which he is employed.

The proper spirit of coöperation cannot be obtained unless square dealings characterize the attitude of the supervising staff toward the employees of the several departments. Confidence must be obtained, sincerity and honesty must characterize every act, that the foundation for results may be laid on a basis born of square dealings.

I have been one to aid in the establishing of the above conditions, have seen them develop and ripen, until the very helpers of the department who have swept the shops and carried out the cuttings have come to me with suggestions for the good of the service. What has been true of the helpers has also been true of the handy men and mechanics. The spirit of freedom to address the foreman opens the way for each one to deal with his particular line of work whether machine, vise, floor or erecting. Coming in direct contact each day with the several lines of work that they handle they become more familiar with each part than any supervising officer can be, and thereby develop ideas regarding the handling of it, that if accepted prove a saving factor in the output of the department.

Other methods have been employed, such as a suggestion box, etc., the same being placed at the office door to receive any suggestions from the employees. This is a good means to employ, but the best results to be obtained in any line, can only be accomplished by the manifestation of those noble characteristics that beget confidence from the head of the staff down to the most humble position in the service, this being backed by honesty and square dealing. When this spirit is manifested and the methods as above outlined put in practice, tangible results will be obtained.

DRAWING ROOM TONIC

BY MILLARD J. COX

Asst. Supt. Machinery, Louisville & Nashville, Louisville, Ky.

A drawing room that deserves the name should be ahead of the shop and continually in the lead as a bureau of information; otherwise it may as well be called the "copying" room.

When a draftsman, for relief, I often sought the shop, running intentionally into some bright mechanic for a brief new

thought. One of my favorites was an old English machinist who gave me many a helpful tip. They were old to him, I've no doubt, but they were brand new to me. I was a frequent visitor to his bench. Valve gear, condensers and high-class stationary engines were his hobbies. A pattern-maker friend was a great mathematician, and when in the humor for this kind of recreation, I found him always ready with a new "nut to crack." Complicated cylinder designs and propeller blades were his special diet, with algebra and geometry for dessert. A boiler maker man was fat, grouchy, and as rough as pig iron, but much alive to the interesting problems concerning scientific boiler laying out, staying, strength of materials, machine against hand work, and costs. These geniuses, all brilliant mechanics of the old school, have passed away, but their stimulating influence is at work, and still furnishes some inspiration for these exacting times and conditions.

Next to having a real genius for the head of the drawing room, I know of nothing that brightens the wits and sharpens the mechanical appetite more than to have a small modern library accessible to the men and boys, and a reading table on which the leading scientific and mechanical journals are to be found. This store of knowledge should be in a conspicuous place, and some one in charge to see to it that these valuable tools are always in order according to dates. The most striking articles should be marked, and later on clipped and added to their proper groups in the files or scrapbooks. The next thing to having the information in mind is knowing where to lay hands on it instantly. To follow out this scheme systematically, have the names of all the men pasted on the back covers, and require them to check the dates opposite their names when they finish reading. There is no objection to taking the papers home at night. The majority will respond to this, if your experience is anything like mine.

Invite the bright fellows to write articles occasionally for publication, and encourage all ideas of merit. Volunteer your service as a friendly critic. A good, stiff problem, requiring research, will stir up the younger ones, and cause the older ones to take notice.

Draftsmen should make opportunities to visit the shops frequently to study the various operations. If our architects and draftsmen would get out and see their designs actually in use, and note what a mess they make sometimes, the shock would do much toward improving their mechanical ambition, provided they are not hampered by a too great opinion of their importance.

Another good tonic is to take the opposite view from your designers, as if you were in earnest about it, and in this way draw out all the points until the subject is threadbare. When you unexpectedly do this several times, your right-hand men will find out you are not to be satisfied with a single idea, and they will furnish a greater variety in the future from which to select.

The main difference in men is their way of thinking. Furnish your force sound leading thoughts, good mechanical ideas and helpful literature. It will always prove a worthy investment, and one that will always tend to tone up effectively the entire personnel.

SLUSHING COMPOUNDS.—These compounds often fail to accomplish their purpose fully owing to the low melting points of the greases used. In oversea shipments where transportation through warm climates is involved the greases are apt to become fluid and the unprotected metal is then attacked. To remove this possibility, some shippers have reverted to the old white-lead and tallow coating. This is mixed with 4 lb. of tallow to 1 lb. of white lead, the latter being stirred into the melted tallow. This mixture affords an excellent protection against rust, but because of the acid in the tallow it should be removed at the earliest opportunity. For this purpose kerosene or turpentine will be found effective.—*American Machinist.*

NOTES ON THE BUTTON-HEAD RADIAL STAY

BY JOSEPH SMITH
Lorain, Ohio

The button-head radial stay plays an important part in the construction of the modern locomotive boiler, and as such it should be given as much care in the applying and upkeep as any other part; yet how often do we find, when calking becomes necessary, that the tool is held as shown in Fig. 1; it does not take many such calkings to make it resemble a door-knob.

Where care is exercised and the tool held as shown in Fig. 2 the life of the bolt-head is prolonged and further leakage avoided, provided the crown-sheet is not muddy and the bolt has been properly applied in the first place. By being properly applied, I mean that it should have a snug fit, but not so tight that it requires a wrench 60 in. long and the pulling power of two men to screw it up to the sheet. By so doing you are only crushing the thread and paving the way for leaky bolts.

Sometimes the heads fall off. Some claim that crystallization

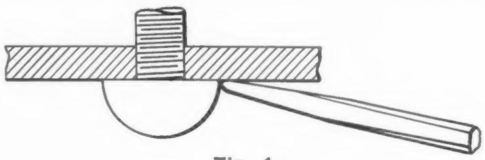


Fig. 1

has set in and it only requires a few blows of the calking tool to knock the heads off. To a certain extent this may be true, but the appearance of some of these heads leads me to believe

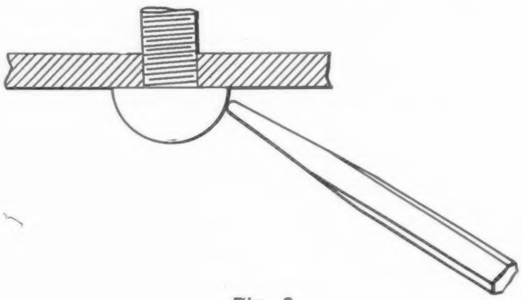


Fig. 2

that possibly there is another reason. In the forging of the bolt the metal has to be upset and crushed into shape between dies whilst hot. It may be that some are not heated to the point

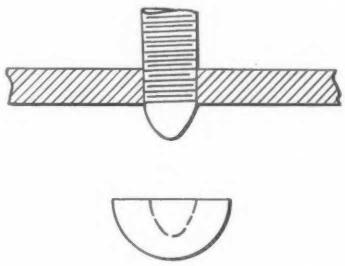


Fig. 3

necessary to form the head into a perfectly homogeneous mass. My meaning will be more clear by noting Fig. 3; the head when it comes off is usually cup-shaped, which leads me to the line of reasoning I advance.

COMPLEX ALLOY STEEL.—In a paper on alloy steels, which formed a part of a symposium presented before the International Engineering Congress, it was pointed out that practically none of the constructional steels contain three or more alloy metals. The only steel in this class to be considered is what is commonly known as high-speed steel.—*American Machinist.*

Apprentices on the Southern Pacific*

A Great Advance Made in the Methods of Instruction and Training Employed on That System

BY THOMAS G. GRAY
Apprentice Instructor

The first apprentice school on the Southern Pacific was started in the fall of 1911 at the West Oakland (Cal.) shops. A year later the management decided to extend educational opportunities to the apprentices at all of the division and general shops on the system. Classes of apprentices were organized at the three largest shops—Sacramento, Cal.; Los Angeles, Cal., and Sparks, Nev.—on January 1, 1913. Since that time schools have been started at San Francisco, Cal.; Dunsmuir, Cal; Brooklyn, Ore., and Ogden, Utah, making a total of eight apprentice schools now in operation on the system with an enrollment of 450 apprentices.

INSTRUCTORS TAKEN FROM THE SERVICE

The work of organizing and conducting these schools was, with but one exception, placed in the hands of men taken from the service, either draftsmen or mechanics of unusual training. Some of these men are college graduates and all of them are experienced in shop work.

In entering on such a new field of work as the organizing of apprentice schools, these men were at once impressed with the need for some available source of information from which to draw for guidance and help. Such a source is now being supplied through the admirable work of The National Association of Corporation Schools. Valuable help was obtained from articles published in the various railroad journals during the past few years and the fruit of much experience was cordially and generously given by leaders in educational work on the roads which have pioneered in this movement.

Upon the establishment of the earlier schools on the Southern Pacific each instructor worked out courses of instruction according to his own ideas, learning by experience as he progressed. In January, 1914, a meeting of Southern Pacific apprentice instructors was held at Reno, Nev., as a part of a safety conference under the auspices of the University of Nevada. At this conference two vital needs for the development of the work were set forth in a recommendation to the management—first, that the work of training apprentices be organized under a central head, and, second, that standard courses of instruction be compiled.

HOW THE SCHOOL WAS INSTITUTED

Early in July, 1914, the work of compiling courses of instruction for the various trades was started and two months later a meeting of the instructors was held at Sacramento to go over the work outlined and to adopt standard courses from the combined ideas of all. Rules governing the employment and training of apprentices, including schedules of shop experience, were also adopted at this meeting. These rules received the approval of the management and were put into effect February 1, 1915. The standard instruction courses were approved by the management and put into general use on September 1, 1915.

In compiling the standard instruction courses a general plan was followed, which, it is felt, answers in a practical and thorough way the needs of the shop apprentice as he progresses.

THE PLAN OUTLINED

The following outline of this general plan will be of interest, and it is hoped that it may prove helpful to those who are undertaking the compiling of courses.

First: A general problem course to be completed by every apprentice entering the schools. This course includes instruction in all the principles of arithmetic from simple addition through ratio and proportion, the more common applications of mensuration and simple problems involving applications of the elementary principles of mechanics. In general the type of problem included in this course is the general railroad problem and not that pertaining to the work of a specific trade. This latter type of problem is included in the specific trade course which will be explained later. The need for a general problem course covering a complete review of arithmetic, as a foundation for apprentice instruction, will be readily conceded by all who have had sufficient experience to realize the general deficiency of grammar school graduates in this most important subject.

Second: A general introductory course in geometrical and mechanical drawing to be completed by every apprentice and to be carried on simultaneously with the general problem course; that is, an apprentice to work for one hour of his two hour period on the problem course, and one hour on the introductory course in drawing. This course is simply an introductory course and nothing more. Its purpose is not to teach geometrical and mechanical drawing, but simply to set forth in a clear and thorough way, those principles of drawing which must be applied later in the making of sketches. A mechanic to make a clear, understandable sketch must know the principles of drawing; he must know how to place the views, and it is the purpose of this course to explain and apply such fundamental principles of drawing as are used in the making of a good, clear sketch. The geometrical problems included in this course are those most likely to be of service to a mechanic in laying out work.

Third: Upon completion of the general problem course, and the general introductory course in geometrical and mechanical drawing each apprentice takes up the study of his particular trade course. This includes:

(1) A set of problems bearing particularly on the work of the trade.

(2) A thorough exercise in the reading of working drawings. The assignments for this work pertain to blue prints of standard Southern Pacific drawings.

(3) A thorough exercise in free-hand sketching from models taken from each trade. These models are numbered and graded so as to make the sketches increasingly difficult. For boilermakers and tinsmiths, in addition to the exercises in reading working drawings and free-hand sketching, there is provided a thorough course in laying out patterns suited to the needs of each trade. These patterns are laid out on large sized wrapping paper and then cut out and turned to the desired shape.

INDIVIDUAL PROGRESS CHARTS

In the larger shops, where the number of apprentices warrants, shop instructors are employed who give their entire time to this work. The schedules of shop training for the several trades are followed as closely as possible, and in order to insure to each apprentice a well rounded training, an individual progress chart is kept showing graphically the amount of time spent on each part of the work outlined in the schedule. Entries are made on these charts twice a week by the school instructor when the apprentices are attending school. Shop foremen and shop instructors are kept informed by the school instructor when apprentices have completed their prescribed time on the dif-

* From an article in the January, 1916, Bulletin of The National Association of Corporation Schools.

ferent classes of work. A seniority chart is posted in the school room and advancement is strictly according to seniority.

All records and progress charts are kept open to the apprentices, and the instructors consult freely with them concerning their progress and make an effort, so far as practical, to let each one specialize along the particular line for which he seems most fitted or in which he may show a continued interest.

The system outlined above is having the effect of bringing the shop and the school in close touch. In making the entries on an apprentice's progress chart, the school instructor must of necessity ask him questions about his work. The answers given not only serve as a basis for the record kept, but very often lead to little conversations which help the instructor to learn where the weak points in the shop training are. He is then in a position to take the necessary steps toward investigating and remedying defects, and so the system improves.

GAINING CONFIDENCE OF STUDENTS

Experience has proved most forcefully that where the attitude of the instructor is one of genuine friendly interest, the boys will gradually place more and more confidence in him and will finally look upon him as their champion; this places the instructor in a position of peculiar helpfulness both to his company and to the apprentices. By remedying defects in the shop training of the boys, he demonstrates to them his interest in their welfare, and by standing openly and unswervingly for the exercise of conscience and honesty in the performance of work, he helps in building up of an efficient and reliable working force.

Owing to the short time which the new apprentice system has been in operation on the Southern Pacific the results attained so far as they can be expressed in figures would not particularly impress the casual reader. But to those who come in daily contact with the apprentices, the results of less than three years' work are clearly indicative of the fact that apprentice instruction is to be regarded as an investment and not as an expense.

WHAT THE WORK ACCOMPLISHES

Some of the observations which are commonly heard about the shop and which would tend to establish the truth of the above statement are:

(1) A better class of boys apply for apprenticeships.

(2) The boys show more interest in their work and are more attentive to their duties.

(3) The boys display more thought and judgment and are not so dependent as they formerly were.

(4) The so-called "arts and mysteries" of the trades are vanishing and boys now learn early in their apprenticeships to perform work which, in former times, was jealously guarded by the "old time" mechanic.

(5) Boys are being encouraged to give their suggestions both in the interest of safety and efficiency. As they see their suggestions acted upon, and as they receive acknowledgment for them, they come to feel a personal interest in the affairs of their shop. No statement can be given either in figures or words which can show the direct or indirect benefit which comes to any company through its educational work. To the extent that such educational work is conducted by men who command the respect and confidence of the young employees, will the benefits of educational work exceed those of mere instruction. For this reason, the apprentice instructor both in the school and in the shop should be a man of large ideas as to the possibilities of his work.

The excellent article by George M. Basford on "The Training of Young Men with Reference to Promotion," which appeared in the Railway Age Gazette of July 23, 1915, has borne fruit in the Southern Pacific apprentice schools through the introduction of a system by which promising young men in the service are periodically "sized up" on a blank enumerating desirable characteristics as outlined in Mr. Basford's article. This system has already been used to good advantage in choosing young men for advancement.

WHAT THE FUTURE HOLDS

While the record of the modern apprenticeship system on the Southern Pacific has been one of rapid development and gratifying results, the future must be one, not only of greater perfection along present lines of activity, but of advancement along other lines which come legitimately within its sphere.

Probably the most pressing present need is for a more complete organization of the apprentice system. To completely standardize the present instruction work at all points on the system, as well as to inaugurate and direct work along more advanced lines, requires a central head. An officer in charge of the educational work would supply to the instructors a uniform backing and support independent of the co-operation, or lack of co-operation, of their local shop superiors.

A very much needed branch of the work of instructing apprentices is that which would open up to them the possibilities for greater efficiency in shop operations. This subject, taken up and followed in a progressive and systematic way, seems thus far to have received but little attention throughout the country. The experience of all who have undertaken the work of demonstrating the possibilities for increased output from shop tools and from shop methods generally has shown the need for a campaign of education calculated to remove blind prejudice and to instill an appreciation of scientific methods for carrying on shop work. This subject belongs to the apprentice school primarily, for our best work along this line can be done by creating in the minds of the rising generation of mechanics a correct view of the purpose and merits of the efficiency movement in industrial life.

SELECTING YOUNG MEN TO DEVELOP

Within our apprentice schools are many young men of unusual intelligence and ability. The near future will doubtless see the establishment of special apprenticeships for these young men, by means of which they may be given the opportunity for a more complete training within the mechanical department. From such material we shall be able to draw our future foremen. This subject must receive careful and continued attention if we are to build up an organization of the highest order.

Undoubtedly a most valuable work can be accomplished through the apprentice schools in the gradual building up of a better and more cordial relation between employer and employee. The apprentice instructor stands in a position of exceptional advantage in this regard. In a very real way he acts as the interpreter of his company's policy toward its employees. If humanity and squareness are the chief characteristics of his attitude toward them he can do much toward developing, as the years go by, that feeling of unity and co-operation which is always the basis of the most successful organization.

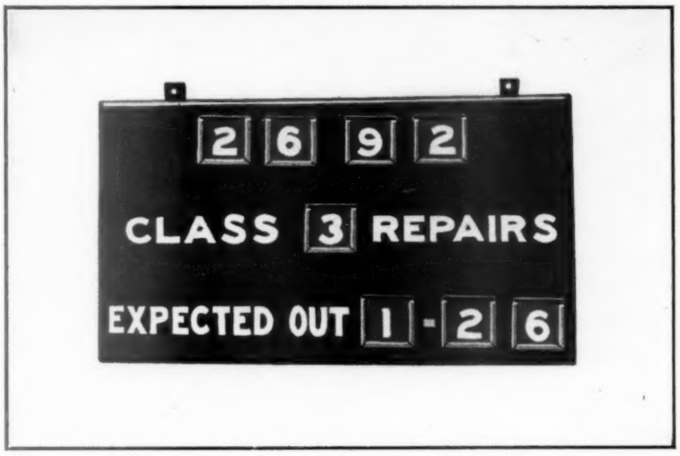
LOCOMOTIVE REPAIR INDICATOR

To any one, either workman or an officer, passing through the average locomotive erecting shop, it is more or less difficult to determine the numbers of the locomotives, or the class of repairs which they are receiving. Ordinarily even the workman engaged on any particular locomotive can only hazard a guess as to the date it is expected to be out of the shop. It is the practice in some shops to have printed lists of the engines in the shop and the class of repairs they are receiving, with the dates when they are expected out, these lists being distributed among the various departments. This is a good system so far as it goes, but there should be a record on the locomotive itself, placed where it can easily be seen. The method of painting signs showing the dates the engines came into the shop, and when expected out, is not very satisfactory as for various reasons it often becomes necessary to change these dates.

The indicator card shown in the illustration is so simple and the numbers so easily changed that it will at once commend itself to any one who has supervision over the repairing of locomotives or any class of machinery where it is desired to show class of work and date on which it is expected out of shop. The

card is made of tin, painted black, rectangular in shape, 10 in. by 18 in., with suitable holes or clips at the top for attaching the wire by which it is hung up. Near the top of the card are soldered small strips of tin forming slides or pockets. There are four of these pockets for the engine number. In the center is placed a slide or pocket, between the words CLASS REPAIRS, and three slides are placed at the lower right-hand corner, preceded by the words DATE EXPECTED OUT, which are painted on the card. These are for the month and day of the month.

The interchangeable numbers, of which there should be quite



Locomotive Repair Indicator as Used in the North Springfield (Mo.) Shops of the Frisco

a number, are painted on squares of tin, two inches square, with the top edge bent over at right angle to facilitate removal from the pocket. The card shown in the illustration indicates engine number 2692, undergoing Class 3 repairs, and expected out of the shop January 26. Should it become necessary to change this date to February 1, a 2 would be substituted for the 1, and the 2 and 6 would be removed and 1 placed in the last pocket. On roads where letters are used to designate class repairs, the letters indicating light, heavy, general, or wreck, may be used in the central pocket. A piece of ¼ in. x 1 in. iron, bent at a right angle, with a small hook on one end and the other end bent down so as to slip into classification lamp bracket, makes a good place to hang the card. This places it about eight inches to one side of smoke arch, but still leaves it parallel with the frame; in this position it is not disturbed by the removal of the front ring or by the men removing or replacing tubes or steam pipes. The indicator card illustrated is used on the St. Louis & San Francisco.

REAL EFFICIENCY IN SHOP OUTPUT

BY JOHN V. LACOMPTE

The greatest factor in effecting and maintaining shop efficiency is competent supervision, the highest standard of which cannot be gaged by the number of locomotives repaired per month, or by the record that can be made in the repairing of one locomotive at the expense of the others in the shop. Economy demands that locomotives spend the greatest part of their time in earning money, and the efficiency is governed by the condition of the locomotives as received from the classified repair shops, the handling of the locomotives by engineers and firemen, and the repairs made in the roundhouse.

The best practices of handling the various parts of locomotives and cars are often passed by, not because convincing evidence cannot be produced to prove that better methods can be inaugurated or a better system installed, but because the management is not prepared to meet demands for increased expenditures, seemingly losing sight of the great return from a comparatively small outlay (first cost).

The main repair shops are where the repairing of the locomotives and cars should be handled with the greatest degree of efficiency; it is there that the faulty designs are corrected; it is there that the best machinery is installed (or should be) to take care of every line of work. Where one operator's time is spent entirely in taking care of one line of work, as is often the case, the best results should surely be produced. When efficiency is dealt with fairly, there will not be a crying demand to secure a certain number of locomotives or cars for the month's output, but rather for a higher state of perfection in all lines of work, that the equipment may give effective service continuously and a much greater time elapse between the shoppings.

I do not mean to infer that the largest number of locomotives and cars should not be gotten out, consistent with good workmanship, but I do mean it is not efficiency to slight the work. Quality and quantity combined will produce the best results in the shops; so also technical and practical knowledge combined produces our best mechanics.

GETTING RESULTS IN AN APPRENTICE* SCHOOL

BY HAROLD V. STYERS
Warwick, N. Y.

It was my good fortune to help start the apprentice school on the Lehigh Valley, where I was a student for one year when I completed my time and lost my rights to the school. After I had been with my present employer about two months and had made the acquaintance of a number of the apprentices, I told them the way boys were learning their trades on some of the larger railroads. This started them to thinking and aroused their desire for something better.

In company with another young machinist and the general foreman we called a meeting one noon after lunch. After telling the boys actual facts about my apprentice school training and the advantages offered by the larger roads to their apprentices, the boys decided to meet every noon after lunch for about 40 to 45 minutes. As our company is small, we did not ask for any equipment, but made use of the things we had at hand. We had a small room over the storehouse that could be utilized for a school room. We secured a sheet of 1/16 in. steel about 4 ft. by 8 ft. and painted it a flat black and set it on a roughly constructed easel. The car department gave us some old coach seats. The storehouse furnished some old out of date reports, which supplied us with paper. We nailed these on ½ in. by 12 in. by 14 in. white pine boards and gave one to each lad to hold on his knees to figure on. The boys supplied their own pencils.

With plenty of chalk and an eraser we were ready to go to work. I undertook to act as instructor and with the help of all, we certainly enjoyed our noons—in fact one o'clock came too soon.

I started in at the beginning of arithmetic and gave the boys the advantage of all the short cuts I could get hold of to keep them interested. While we were working in decimals, I took a pair of micrometers to show them how important it was to have a good command of decimals and fractions. As different things came up in the shop that we could figure on, we would get the dimensions and work them out. For instance, we figured the amount of water in gallons that could be put in the cistern of one of our tanks. We have also figured the difference in the heating surface in an engine equipped with a superheater and one of the same class without the superheater. I have also taught some of the young machinists and boilermakers between 5 and 6 p. m. twice a week.

If I had the equipment, I would teach the boys enough mechanical drawing so they could make a sketch of a piece of work they might want made, read a blue print quickly, or lay out a

* Entered in the competition on "How Can I Help the Apprentice?" which closed September 1, 1915.

piece of work to be machined. It is always well to have some stiff problems for the last of the lesson to keep all hands busy; also mix up with the boys and assure yourself that they are all started right.

DRIVING BOX REPAIRS

BY R. L. PRESTON
Machinist, St. Louis, Iron Mountain & Southern, Argenta, Ark.

The article on "Driving Box Repairs," by P. E. Smith, published in the October issue of the *Railway Age Gazette, Mechanical Edition,* on page 527, was of particular interest to the writer, who is engaged in driving box work. Considerable improvement in driving box practice has been effected at this point during the past year, largely through a more general use of second-hand brasses.

On January 1, 1915, the writer started a record of all new and second-hand brasses used, to see what could be saved on driving box supplies in one year. Previous to that time there were very few second-hand brasses used. As from four to eight boxes are received to the set, six boxes may be considered an average set. For the nine months ending September 30, 1915, 158 sets of driving boxes were handled. The driving box gang consists of three machinists, one apprentice, one helper and one handy-man. There are one machinist and a helper on the bench, who strip all boxes and do the floor work, such as laying off the brasses, pressing them in, and fitting the cellars. Whenever a cellar is loose in the box, it is tightened by riveting a liner of the necessary thickness (very seldom more than 1/16 in.) on one side of it. Cast iron hub plates are used on driving boxes instead of babbitt, as we find they give better satisfaction. They are held in place by counterboring the box and driving four taper-headed pins 25/32 in. in diameter into ¾-in. countersunk holes. These pins never work loose. Our average time on one set of six driving boxes is eleven hours and five minutes. The gang is seldom worked to full capacity.

Our average on the brasses used for the nine months from January 1, 1915, was 54 per cent new and 46 per cent second-hand. The weight of the new brass used was 66,720 lb., which, at a cost of $15.75 per 100 lb., is $10,508.40. The weight of the second-hand brass used was approximately 33,000 lb., which, at a scrap value of $14 per 100 lb., is worth $4,620. If new brass had been used instead of the second-hand brass, 56,835 lb. would have been required, which, at a cost of $15.75 per 100 lb. would have cost $8,952. The difference between this and the $4,620, the value of the second-hand brass, is $4,331, or the saving made by the use of the second-hand brass.

The method followed in handling a set of boxes from the time they are taken from the wheels to the time they are ready to go on again is as follows:

First: Mark all boxes and brasses and press out the brasses with a hydraulic press.

Second: Remove the cast iron hub plates by drilling off the heads of the plugs which hold the plates in place.

Third: Fit new brasses, or shim and close the old ones.

Fourth: Fit the old brasses or lay off the new brasses.

Fifth: Shape the edge of the brasses on a Newton vertical miller. (See Figs. 1 and 2.)

Sixth: Press the brasses in the boxes at 20 to 40 tons pressure.

Seventh: Plane the boxes.

Eighth: Fit and drill the cast iron hub plates and drill the boxes for the brass plugs.

Ninth: Face and bore the boxes to fit the journals. Note the driving box chuck in Fig. 3. This is a universal chuck, and was built in this shop.

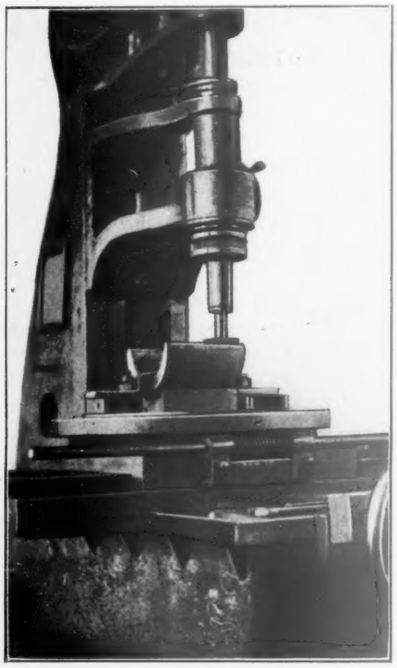


Fig. 1—Milling Driving Box Brasses

Fig. 2—Milling Driving Box Brasses

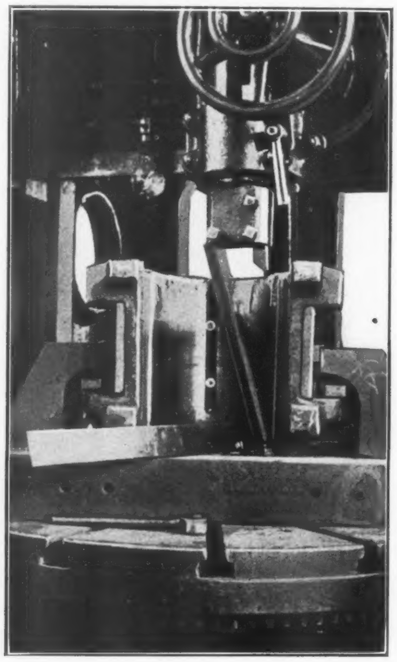


Fig. 3—Boring Driving Brasses with Universal Chuck

Tenth: Place the cellars in the driving boxes and truck them to the wheels.

This gives the complete working order in which driving boxes are handled at this place. The following is the time it would take one man to complete a set of six driving boxes. The time mentioned in the first part of this article is our average time for nine months, using two boring mills on box work.

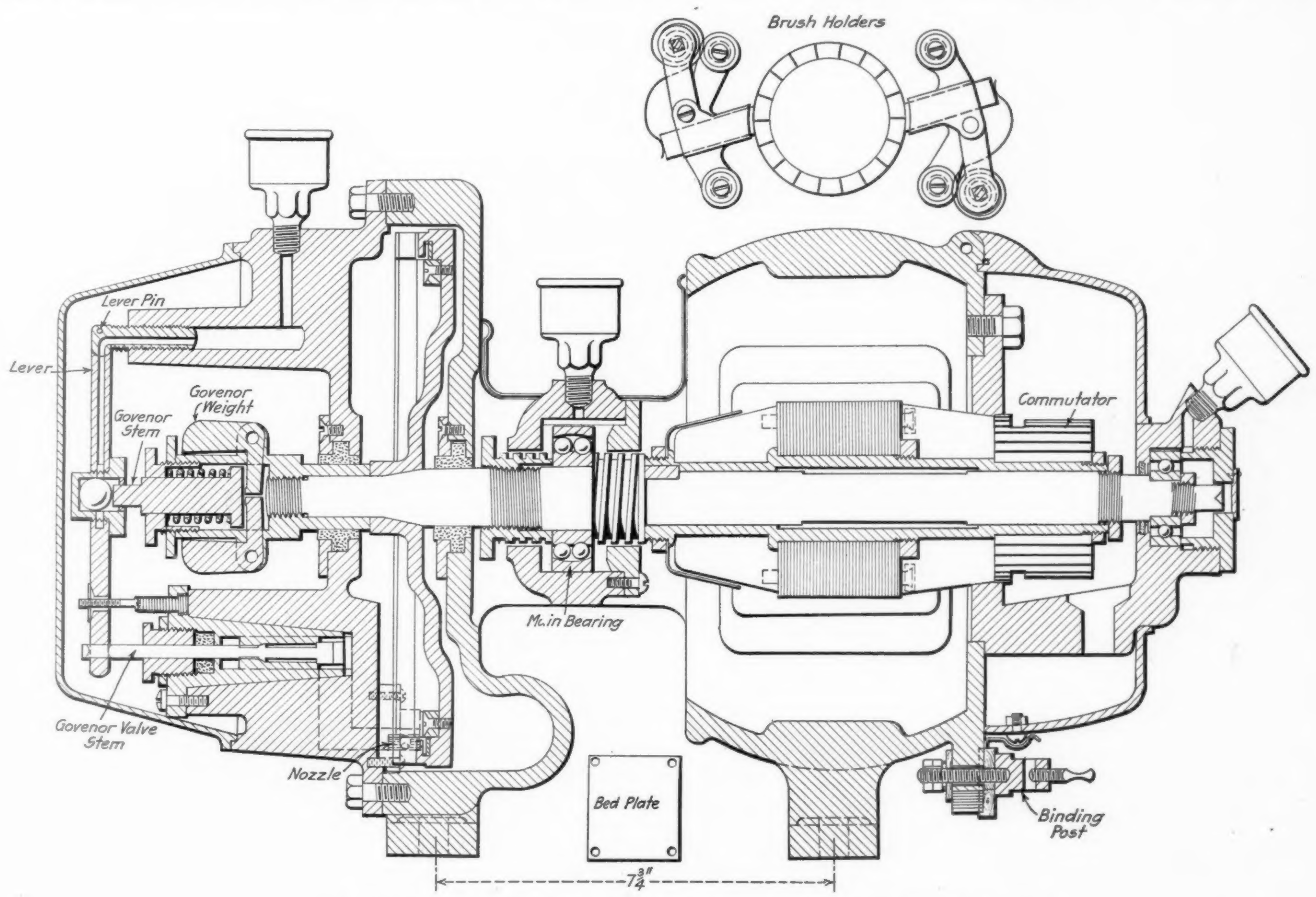
Press out the brasses and drill off the hub plates	30 min.
Cut six liners and place them in the boxes. Close six brasses, chip and set them in the boxes	37 min.
Mill six brasses	1 hr.
Press six brasses into the boxes	16 min.
Plane six driving boxes	3 hrs.
Fit six cast iron hub plates	3 hrs.
Drill six hub plates, pin the plates on the boxes and drill the plug holes in the brasses	2 hrs. 10 min.
Face and bore six boxes (cast iron hub faces)	9 hrs.
Fit the old cellars in the boxes	1 hr.

The total time for one man to complete six driving boxes will be 20 hours and 32 minutes. When new brasses are used the time will be 22 hours 30 minutes for 9-in. by 12-in. journals.

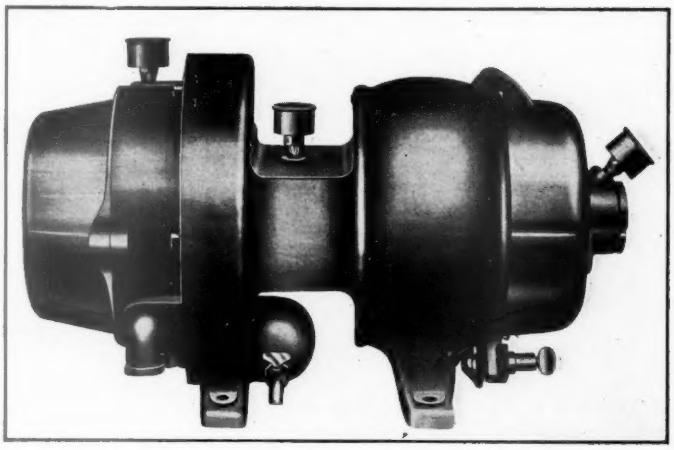
NEW DEVICES

INCANDESCENT ELECTRIC HEADLIGHT

To meet the demands of the railways for incandescent headlight equipment the Schroeder Headlight Company, Evansville, Ind., has for the past few years given much attention to the development of this equipment. At the present time it has on the market three types of equipment, namely, the 6-volt turbo-generator having a capacity of 150 watts, and two 32-volt turbo-generators having capacities of 350 watts and 1,000 watts, respectively. The 32-volt, 350-watt system has had the most extensive use up to the present time, it being the first of the incandescent equipment of that company to be placed on the market. It has already been made standard on some roads in view of the service it has performed. The following is a statement of the yearly maintenance cost of eight of these equipments reported by a road operating in the Middle West:



Sectional View of the 32-Volt, 350-Watt Headlight Generator Equipment



Schroeder 32-Volt, 350-Watt Headlight Turbo-Generator

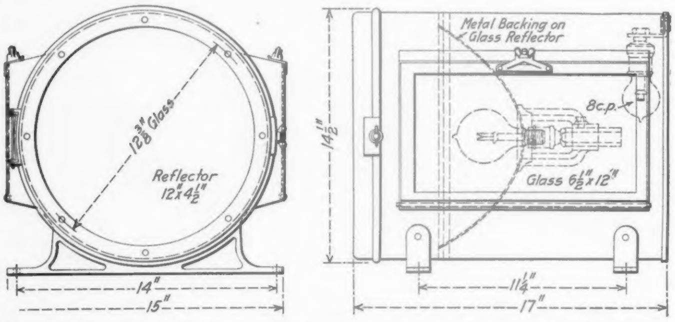
Repairs to turbo-generator*	$ .75
Labor and cost of lubrication	39.84
Incandescent headlight lamps	43.20
Incandescent cab lamps	8.51
Total	$92.30

* This item was for carbon brushes, showing a perfect record for the mechanical construction of the machine.

This is an average of $11.54 per machine per year. This road uses 150-watt concentrated filament lamps on its road engines and 60-watt lamps of the same type at the front and back of the yard engines. The equipments are handled by the roundhouse machinist, who examines the brushes and generator about every 1,000 miles. Another road operating 212 headlights of this same type finds that with 100-watt, 125-candle power lamps the requirements of the Illinois state laws are more than met. Tests of the 32-volt equipment made by this road with equipments which have been in service six months showed that the voltage did not vary more than 2¾ volts between boiler pressures of 100 lb. and 180 lb. This road also reports favorable mainte-

nance costs, stating that they do not amount to one-half that spent for the arc light equipments.

The headlight equipments made by the Schroeder Headlight Company are all of the same general design, the only difference being in the size of the equipments. They will operate at any pressure from 75 lb. up. The 32-volt outfit weighs 175 lb., and is 13 in. high, 24 in. long, and 12 in. wide. The body of the generator and the turbine is cast in one piece, insuring strength, rigidity and bearing alinement. Both the turbine wheel and the armature are fastened to the same shaft, which rotates on two

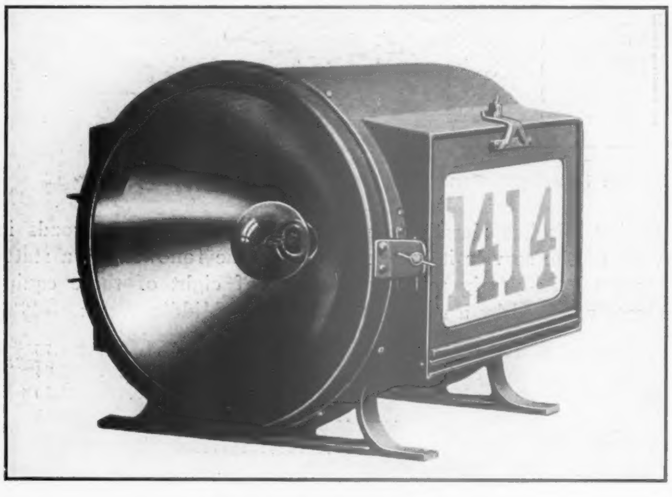


Arrangement of Reflector and Number Plate Lamp in the Sunbeam Headlight

sets of ball bearings, one located between the generator and the turbine wheel, and the other at the commutator end of the equipment. The generator is of the two-pole type and operates at a speed of 2,400 r.p.m. The commutator is made extra heavy, and will permit of several machinings before renewal is necessary. The armature can be removed quickly; the outside bearing housing is readily removed by taking out three cap screws and one retaining nut.

Steam from the boiler is admitted to the turbine through a governor valve that is automatically controlled by a centrifugal governor on the end of the turbine shaft, which, by regulating the valve opening, maintains constant turbine speed.

In designing this turbo-generator care was taken to keep all parts easily accessible for inspection or repairs, and to provide large bearings. A detachable outer shell at either end provides



The Sunbeam Headlight

almost instant access to the governor on one end and the armature on the other. Further removal of a cast iron housing, which is held by set screws, gives access to the turbine wheel or armature. Lubrication is provided for by grease cups and large grease wells which surround the ball bearings, making daily attention unnecessary.

The six-volt turbo-generator system is the latest development. It has a capacity of 150 watts at 2,400 r.p.m. The weight is 120 lb., and the over-all dimensions, 14 in. by 19 in. by 15 in. high. The machine is built either with or without the throttling governor. When used without the governor the speed is kept practically constant by means of a reducing valve supplemented by a patented friction device which prevents excessive speed. Grease is prevented from leaking out of the bearings by bushings having spiral oil grooves cut in them, which tend to return the lubricant to the bearings. This effects economy in lubrication and also prevents grease from getting on the generator windings.

This company also makes the headlight case and fixtures, which is known as the "Sunbeam" headlight. It is made for either a 6-volt or a 32-volt system, the only difference being in

Adjustable Focusing Stand for Old Type Headlight Cases

the incandescent light bulb. It has a heavy 12-in. mirror glass reflector slightly colored to make the light more penetrating. This never needs replating and does not tarnish. The lamp socket is adjustable, permitting the use and accurate focusing of any size incandescent round bulb or concentrated filament nitrogen lamp up to 250 watts. The distance at which objects can be discerned varies from 800 ft. to 2,000 ft., depending on the type of lamp used.

Number plates are provided at each side of the headlight, which are illuminated by a small bulb at night.

The headlight case is substantially constructed of metal; the doors are swung on heavy hinges and secured, when closed, by thumb screws, making it dust proof. It is supported by heavy

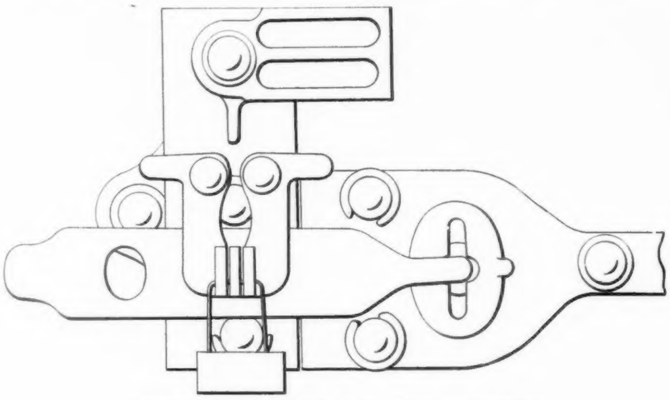
iron brackets riveted to the body of the headlight and bolted to the support on the locomotive.

Headlights with other types of reflector can be furnished in any special size and design having any size or type of number plate. This company also makes adjustable stands for incandescent bulbs for use in old type headlight cases, having large or small reflectors. These stands are adjustable to permit of properly focusing the bulb.

EFFECTIVE CAR DOOR FASTENERS

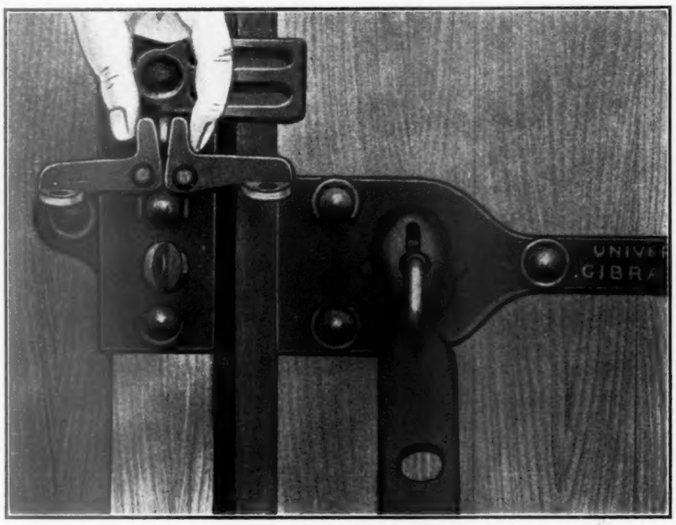
Two box car door fasteners are illustrated herewith which have been designed to meet all M. C. B. requirements as to construction and which are burglar-proof. Both are adapted to the use of any type of car seal and may be fastened with a padlock with equal facility. These fasteners are made by the Universal Car Seal & Appliance Company, Albany, N. Y.

The metal door stop of the "Universal Gibraltar" fastener



Universal Gibralter Car Door Fastener

carries two gravity pawls which swing down against the hasp lug. Through the ends of these pawls are holes which are in line with the hole through the lug. When the hasp is in place these drop down in front of it, and when a seal has been applied through the registering holes in the pawls and lug, it is impossible to remove the hasp without breaking the seal. The operation is very simple; it is necessary only to spread the pawls by compressing the outward extending upper ends between the



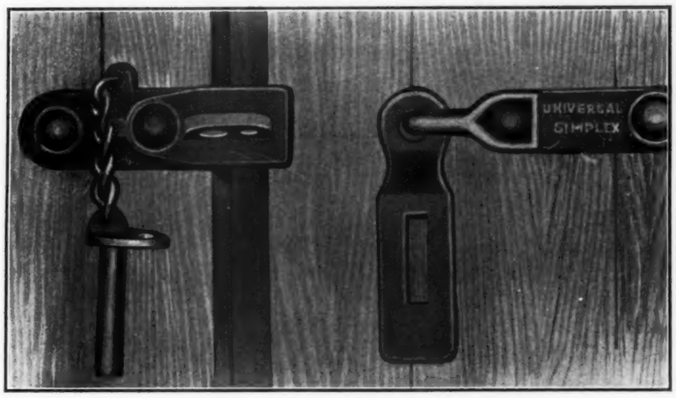
Method of Operating

thumb and forefinger of the left hand while the hasp is handled with the right hand.

The door stop is a channel casting of malleable iron which envelopes the car door stop, and serves also as a door guide. Both this and the door strap are gained in on the adjoining faces, thus providing flush metal surfaces of contact. The prying of doors which stick or bind is thus possible without injury to the woodwork.

All bolts are fastened inside the car, so that removal from the outside is impossible and none of the parts can be separated without removing the fastener from the car. It is made of malleable iron throughout and weighs 12 lb.

The "Universal Simplex" door fastener is a lighter and cheaper device than the one above described, having a weight of only 6½ lb. It possesses the same features of construction to secure

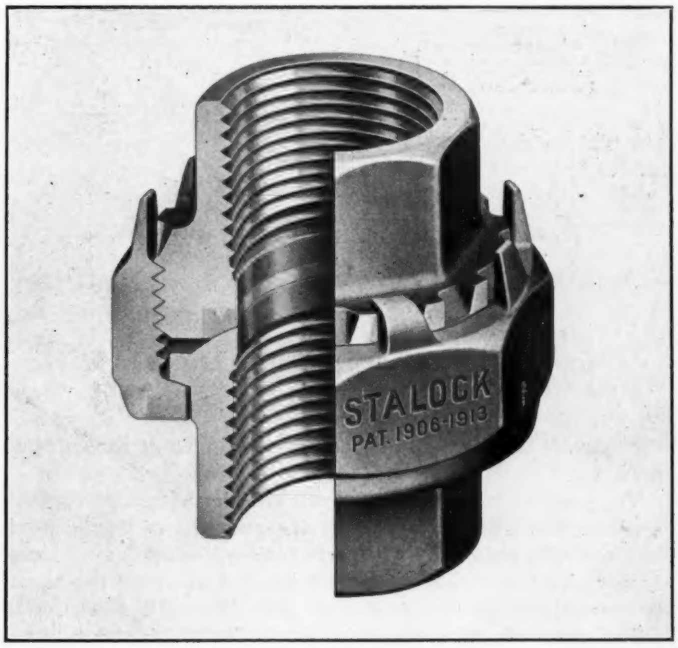


The Universal Simplex Fastener

safety and is easy to operate. The lug is extended to provide for two holes through it. One of these is for the pin and the other for the seal. The pin has a flat head, in which is a hole registering with the second hole in the lug when the pin is in place in front of the hasp. When sealed through these holes the hasp cannot be removed from the post without breaking the seal. The locking pin is secured to the stop casting with 6 in. of heavy welded chain.

A LOCKING PIPE UNION

A pipe union of unusual construction has recently been developed by the Standard Union Company, 612 Winthrop building, Boston, Mass. The features of the device are clearly set forth



The Stalock Union

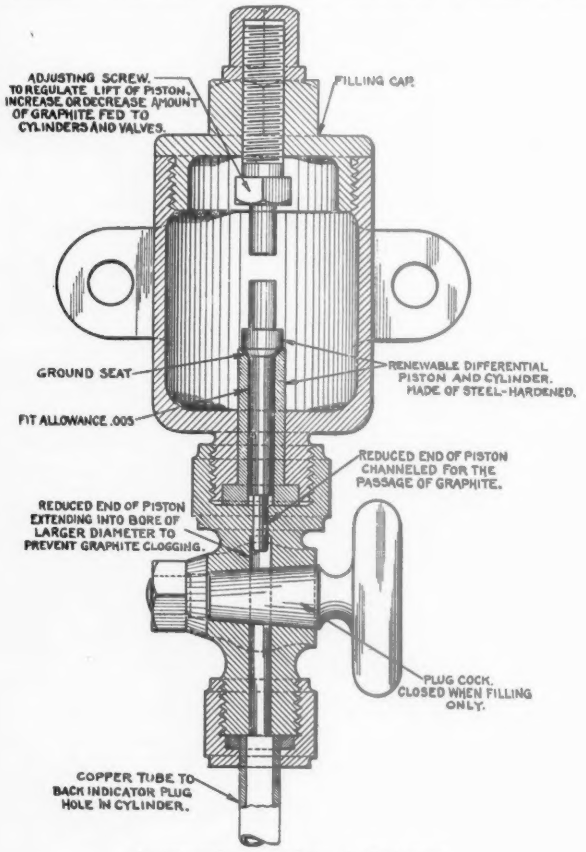
in the illustration, which shows a section of the seat exposed. The union has a ground ball joint, the concave seat being formed in a brass seat ring which is interlocked in position. It thus involves the best modern practice of a brass to iron con-

tact to prevent corrosion. On the upper face of the nut, which is of malleable iron, are cast a number of lugs. The upper body of the union is cast with a number of notches or recesses in the shoulder just above the threads. The shoulder on one side of these depressions is square and the other is sloping. To lock the nut one of the lugs is bent into one of the recesses by a blow from a wrench or hammer, at least two diametrically opposite lugs always being in position to be locked. The square shoulder of the recess prevents the thread from slacking back, but should it be necessary to further tighten the union it may be done without difficulty, as the sloping shoulder of the recess will force the lug out of engagement when the wrench is applied.

This union is known as the "Stalock," and has been developed especially to meet the severe requirements of railroad work.

GRAPHITE CYLINDER LUBRICATOR

A simple device has recently been developed for introducing flake graphite into locomotive cylinders which is entirely self-contained, no motion derived from moving parts of the engine being required. A cup, arranged for attachment to any convenient part of the locomotive, contains the graphite and is connected by a short tube to one of the indicator plug holes in the cylinder. The device is usually attached to some point on



Automatic Graphite Lubricator

the cylinder casting by means of the bolting lugs shown in the drawing.

The graphite cup contains a small cylinder within which works a differential piston operated by the pressure variations in the locomotive cylinder. The graphite is thus worked into the small copper pipe connection and thence into the cylinder; the amount is determined by the stroke of the differential piston. The filling cap contains an adjusting screw by which the stroke of the piston is regulated. A plug cock is placed below the graphite cup to close the cylinder connection when filling the cup.

After the cup has been in operation on a locomotive for a few hours, the valve and piston rods are said to show indications of the graphite lubrication, a deposit being left on them which is visible from the outside. The graphite is carried by exhaust steam into the valve chambers, thus effectively lubricating both the cylinders and the valve chambers. The device is applied without in any way disturbing or altering the existing method of oil lubrication. It merely supplements the oil lubrication. Large quantities of graphite are neither required nor desirable, the best results being obtained by the regular application of small quantities. Tests indicate that one-half ounce fed into each cylinder of an ordinary locomotive for each 100 miles run is sufficient. With this device it is claimed that the amount of graphite used may be very closely regulated and that no objectionable accumulation of graphite on the pistons, cylinder heads or in the steam ports follows its use.

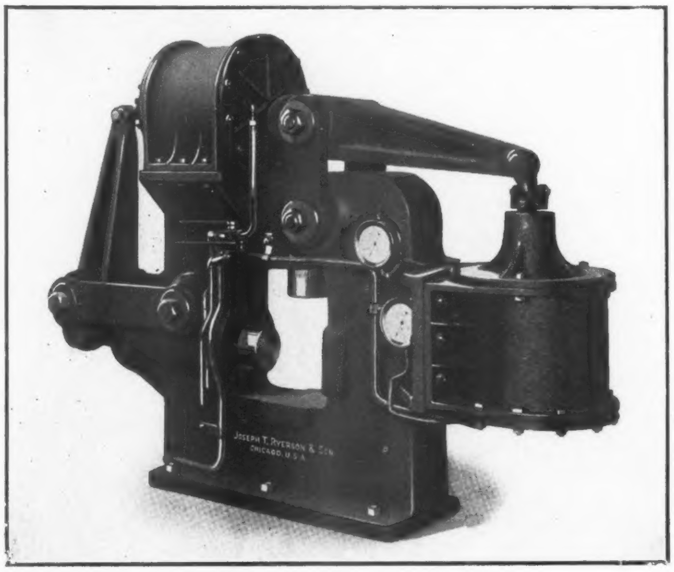
The lubricator has been in service on a number of locomotives for some time. Some of these engines were equipped with superheaters and were operating at temperatures as high as 720 deg. to 740 deg. Fahrenheit in some instances. Under these severe conditions no trouble has been experienced with the lubrication. In a comparative test conducted over a period of about one year, a locomotive equipped with the graphite cup ran 56,000 miles with a total average cylinder wear of .014 inch as against a mileage of 48,000 with a total average cylinder wear of .056 inch for a locomotive not so equipped.

The average packing ring wear in the locomotive lubricated with graphite was only 1/32 in., while the other locomotive received two new sets of rings during the test. The graphite used cost less than one cent per 100 miles, and the estimated saving, based on cylinder and ring wear alone, was approximately $40. Because of the reduced friction, there was also claimed to be an appreciable saving in fuel consumption.

This lubricator has been patented by E. H. Sweeley, Richmond Hill, N. Y.

PNEUMATIC SPRING BANDING PRESS

A pneumatic press for applying bands to leaf springs has recently been placed on the market by Joseph T. Reyerson & Son, Chicago. The machine is especially designed for use in railroad and commercial spring manufacturing or repair shops



Spring Banding Press of 100 Tons Capacity

which are not equipped with hydraulic power. It is operated by compressed air, being designed for 100-lb. pressure. The cylinders are of such a diameter that with this pressure a force of 60 tons is exerted on the rams. The cylinders and levers are attached to a heavy one-piece frame cast in the form of a hollow square, the rams operating in the opening. Each machine is provided with two three-way hand-operated valves and the necessary pressure gages, conveniently located for the operator.

The cylinders are 16 in. in diameter and the machine weighs complete 6,500 lb.

Railway Mechanical Engineer

(*Formerly the* RAILWAY AGE GAZETTE, MECHANICAL EDITION *with which the* AMERICAN ENGINEER *was incorporated*)

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Subscriptions, including the eight daily editions of the *Railway Age Gazette* published in June in connection with the annual conventions of the Master Car Builders' and American Railway Master Mechanics' Associations, payable in advance and postage free: United States, Canada and Mexico, $2.00 a year; Foreign Countries (excepting daily editions), $3.00 a year; Single Copy, 20 cents.

WE GUARANTEE that of this issue 7,800 copies were printed; that of these 7,800 copies 6,888 were mailed to regular paid subscribers, 101 were provided for counter and news companies' sales, 336 were mailed to advertisers, exchanges and correspondents, and 475 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year eo date were 15,600, an average of 7,800 copies a month.

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VOL. 90 FEBRUARY, 1916 NUMBER 2

CONTENTS

NEWS DEPARTMENT

CARS AND LOCOMOTIVES ORDERED IN JANUARY

During the month of January orders for locomotives, freight cars and passenger cars were reported as follows:

	Locomotives	Freight Cars	Passenger Cars
Domestic	231	14,613	310
Foreign	2	11,000	...
Total	233	25,613	310

Among the more important orders for locomotives were the following: Delaware, Lackawanna & Western, 10 Mikado and 7 Pacific type locomotives, American Locomotive Company; Erie, 10 Santa Fe type locomotives, Baldwin Locomotive Works, and 10 of the same type, American Locomotive Company; New York Central Lines, 35 locomotives, American Locomotive Company, including 5 Mallet type engines for the New York Central proper, and 20 Mikados and 10 switching locomotives for the Indiana Harbor Belt. The Pennsylvania authorized its Juniata shops to proceed with the construction of 45 Mikado and 60 switching locomotives for the Lines East of Pittsburgh.

Almost one-half of the freight cars ordered for domestic use were for the Pennsylvania Railroad, which placed orders with the Cambria Steel Company for 3,000 hopper gondola cars, with the Ralston Steel Car Company for 2,000 of the same type, and with its own Altoona shops for 1,000 all-steel box cars. All of the 11,000 cars ordered for export were for France, contracts having been awarded to the Standard Steel Car Company for 5,000 cars, to the National Steel Car Company, Ltd., New Glasgow, N. S., for 4,000 cars, and to the Canadian Car & Foundry Company for 2,000 cars. Among other important domestic orders were the following: Denver & Rio Grande, 1,000 box cars, Pullman Company; Union Tank Line, 1,000 tank cars, Standard Steel Car Company; Missouri, Kansas & Texas, 1,500 gondola cars, American Car & Foundry Company; Lehigh Valley, 1,500 automobile cars, divided evenly among the Standard Steel Car Company, the Pullman Company, and the American Car & Foundry Company; the Bessemer & Lake Erie, 2,000 ore cars, Standard Steel Car Company, and the Baltimore & Ohio, 2,000 cars, Cambria Steel Company, and 1,000 cars, American Car & Foundry Company.

The most important passenger car order reported was that for 200 subway cars placed with the American Car & Foundry

Company by the New York Municipal Railways Corporation. The Pennsylvania ordered 50 coaches, 20 combination passenger and baggage cars and 5 baggage cars from its Altoona shops.

MEETINGS AND CONVENTIONS

Railway Fuel Association.—At a meeting of the executive committee of the International Railway Fuel Association, J. G. Crawford, vice-president of that association, and fuel engineer of the Chicago, Burlington & Quincy, was appointed secretary-treasurer, succeeding C. G. Hall, resigned. R. R. Hibbon, assistant fuel agent of the Missouri, Kansas & Texas, was appointed vice-president, succeeding J. G. Crawford, and B. P. Phillippe, coal agent of the Pennsylvania Railroad, was appointed a member of the executive committee, succeeding R. R. Hibben. William Schlafge, mechanical superintendent of the Erie, was also appointed a member of the executive committee, succeeding W. C. Hayes, deceased.

June Convention Exhibits.—President Osby and Secretary Conway of the Railway Supply Manufacturers' Association are enthusiastic over the prospects for a record breaking exhibit during the Master Mechanics' and Master Car Builders' Convention at Atlantic City this year. On Saturday, January 8, a circular was sent out to prospective exhibitors outlining the conditions for making exhibits and stating that allottments of space would be made on February 18, 1916. On January 18, ten days after their circular had been mailed, applications had already been received—and space paid for—for 22,931 sq. ft., or more than 25 per cent. of the total space available. These applications came from 59 firms, six of which did not exhibit last year. A number of former exhibitors have applied for larger space this year. Indications at this time are that applications will be made for more space than it will be possible to provide.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass.
AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—W. E. Jones, C. & N. W., 3814 Fulton St., Chicago.
AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago,
AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—Owen D. Kinsey, Illinois Central, Chicago.
AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.
ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.
CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago. Second Monday in month, except July and August, Lytton Building, Chicago.
CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, Albany, N. Y.
INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick Building, Chicago.
INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn. Convention, August 29-31, 1916, Hotel Sherman, Chicago.
INTERNATONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio.
MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.
MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago.
MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.
NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. Frankenberger, 623 Brisbane Building, Buffalo, N. Y. Meetings monthly.
RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.
TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., East Buffalo, N. Y.

PERSONALS

GENERAL

C. P. BURGMAN, master mechanic of the Chicago, Indianapolis & Louisville at Bloomington, Ind., has been appointed superintendent of motive power, with office at Lafayette, Ind., succeeding H. C. May, resigned.

F. F. GAINES, superintendent of motive power of the Central of Georgia at Savannah, Ga., has been granted leave of absence on account of ill health, and W. H. Fetner, master mechanic at Macon, Ga., has been temporarily appointed general master mechanic, in charge of the mechanical department, with headquarters at Savannah.

J. A. MACRAE has been appointed mechanical engineer of the Minneapolis & St. Louis, with headquarters at Minneapolis, Minn.

H. C. MAY, whose appointment to the position of superintendent of motive power of the Lehigh Valley was announced in these columns last month, began his railroad career with the Chesapeake & Ohio at Covington, Ky., where he served as machinist apprentice from 1892 to 1896. He was then machinist for three years at the same place. In 1899 he became a student in the Mechanical Engineering School of Purdue University at Lafayette, Ind., from which he graduated in 1902. He was then appointed master mechanic on the Cleveland, Cincinnati, Chicago & St. Louis at Louisville, Ky., remaining in that position until 1907. From 1907 to 1910 he served on the Louisville & Nashville as master mechanic at New Decatur, Ala., and at South Louisville, Ky., and since 1910 has been superintendent of motive power of the Chicago, Indianapolis & Louisville until his recent appointment with the Lehigh Valley. Mr. May's new headquarters are at South Bethlehem, Pa.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

G. J. DUFFEY, master mechanic of the Lake Erie & Western, at Lima, Ohio, has been appointed superintendent of motive power, with headquarters at Lima, and the office of master mechanic has been abolished.

W. E. DUNKERLEY has been appointed master mechanic of the Yellowstone division of the Northern Pacific, with headquarters at Glendive, Mont., succeeding E. P. Johnson, transferred.

J. B. HALLIDAY has been appointed acting master mechanic of the Central and Western divisions of the Minneapolis & St. Louis, at Minneapolis, Minn., succeeding William Gemlo.

T. HAMBLY has been appointed acting road foreman of locomotives, district 1, Lake Superior division, Canadian Pacific, with headquarters at Sudbury, Ont.

J. H. HANNA, assistant to the road foreman of engines of the Pennsylvania Lines west of Pittsburgh, Western division, has been appointed road foreman of engines, succeeding C. R. Colmey, deceased.

THOMAS F. HOWLEY, inspector of locomotive service of the Erie, at Port Jervis, N. Y., has been promoted to superintendent

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Feb. 8	Car Construction	K. F. Nystrom	James Powell	St. Lambert, Que.
Central	Mar. 9	Interchange Rules. Discussion	Committee	Harry D. Vought	95 Liberty St., New York
New England	Feb. 8	Our Express Business	E. O. Robie	Wm. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Feb. 18	Pulverized Fuel for Locomotives	J. E. Mulhfeld	Harry D. Vought	95 Liberty St., New York
Pittsburgh	Feb. 25	Malleable Iron—Its Use and Abuse	Prof. Enrique Touceda	J. B. Anderson	207 Penn Station, Pittsburgh, Pa.
Richmond	Feb. 14	Electrification	C. H. Quinn	F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	Feb. 11	The Universal Valve	W. V. Turner	B. W. Frauenthal	Union Station, St. Louis, Mo.
South'n & S'w'rn				A. J. Merrill	Box 1205, Atlanta, Ga.
Western	Feb. 15	Smoke Abatement and Electrification in Chicago	Prof. W. F. M. Goss	Jos. W. Taylor	1112 Karpen Bldg., Chicago, Ill.
Western Canada				Louis Kon	Box 1707, Winnipeg, Man.

of locomotive operation, at New York, succeeding W. C. Hayes, deceased.

JOHN P. KENDRICK, master mechanic of the Buffalo, Rochester & Pittsburgh at Punxsutawney, Pa., has been promoted to master mechanic at Du Bois, Pa.

T. L. REED, assistant master mechanic of the Seaboard Air Line at Hamlet, N. C., has been appointed master mechanic of the North Carolina division, with headquarters at Hamlet, N. C. The position of assistant master mechanic is abolished.

J. D. SEARLE has been appointed master mechanic of the Buffalo, Rochester & Pittsburgh at Punxsutawney, Pa.

G. F. SHULL, acting master mechanic of the Carolina, Clinchfield & Ohio at Erwin, Tenn., has been appointed master mechanic, with office at Erwin.

W. H. STRANG, road foreman of engines of the Chicago, Indianapolis & Louisville at Lafayette, Ind., has been appointed general road foreman of engines.

JOHN WINTERSTEEN has been appointed general master mechanic of the Lehigh Valley, with headquarters at South Bethlehem, Pa. He will perform such duties as may be assigned to him by the superintendent of motive power. Mr. Wintersteen was born in 1875, and began his mechanical experience as a boilermaker at the Lansford shops of the Lehigh Coal & Navigation Company. In 1898 he entered the service of the United States government at League Island, Philadelphia, Pa., and later served at Key West, Fla. He subsequently was in the service of the Baldwin Locomotive Works, then was boiler inspector on the Norfolk & Western at Roanoke, Va., and later served as general foreman in the Richmond shops of the Philadelphia & Reading Railway.

J. Wintersteen

CAR DEPARTMENT

J. HERRING has been appointed car foreman of the Canadian Northern at North Battleford, Sask., succeeding A. H. Sweetman, transferred.

JOHN NEARY, general foreman of the car department of the Chicago, Indianapolis & Louisville at Lafayette, Ind., has been appointed master car builder.

T. REDMOND has been appointed car foreman of the Canadian Northern at Ottawa, Ont.

SHOP AND ENGINE HOUSE

J. BLACK, assistant locomotive foreman of the Canadian Northern at Kamsack, Sask., has been appointed locomotive foreman, succeeding S. Vincent, transferred.

C. T. DOCTOR has been appointed locomotive foreman of the Canadian Northern at Foleyette, Ont.

H. B. KRAFT, formerly foreman of the steel car shop of the Pennsylvania at Altoona, Pa., has been appointed foreman of the truck shop, succeeding J. W. Spangler.

A. MAYS has been appointed locomotive foreman of the Canadian Northern at Edmonton, Alta., succeeding W. M. Armstrong, transferred.

A. TAYLOR has been appointed night locomotive foreman of the Canadian Northern at Winnipeg, Man., succeeding J. Black, transferred.

S. L. TRACEY has been appointed locomotive foreman of the Canadian Northern at Toronto, Ont.

J. WEBB has been appointed locomotive foreman of the Canadian Northern at Bancroft, Ont.

J. H. WILSON has been appointed locomotive foreman of the Canadian Northern at Hornepayne, Ont.

T. YOUNG has been appointed locomotive foreman of the Canadian Northern at Lucerne, B. C.

PURCHASING AND STOREKEEPING

GEORGE W. CAYE, who has been appointed general purchasing agent of the Grand Trunk, with office at Montreal, Que., was born on December 1, 1865, at Malone, N. Y. In August, 1883, he entered the service of the Central Vermont as junior clerk in the passenger department at St. Albans, Vt., and then was successively stenographer and chief ticket clerk until 1897, when he became chief clerk to the general superintendent. In 1900 he was appointed traveling car agent of the Canada Atlantic Railway, with headquarters at Ottawa, Ont., and in 1892 became secretary to the general manager of the same road. During 1905 and 1906 he served as chief clerk to the vice-president and general manager of the Grand Trunk Pacific at Montreal, Que. In 1907 he became assistant to vice-president and general manager and purchasing agent of the same road, with headquarters at Winnipeg, Man., which position he held at the time of his recent appointment as general purchasing agent of the Grand Trunk.

G. W. Caye

J. D. FERGUSON has been appointed general purchasing agent of the Zwolle & Eastern, with office at St. Louis, Mo.

G. E. MOTZ has been appointed purchasing agent of the Ft. Dodge, Des Moines & Southern, with headquarters at Boone, Ia., succeeding H. S. Moore, resigned.

OBITUARY

R. H. CREW, locomotive foreman of the Grand Trunk, at Nimico, Ontario, died in Toronto, Ontario, on December 7, as the result of a stroke of apoplexy. Mr. Crew was 48 years of age and had been in the employ of the Grand Trunk at Nimico for 28 years.

NEW SHOPS

THE NORFOLK SOUTHERN.—This company opened bids on January 15 for rebuilding the shops at New Bern, N. C., which were destroyed by fire on November 16. The total cost will aggregate about $14,000. A contract for the work is reported let to J. Johnson, Norfolk, Va.

Supply Trade Notes

Frederick H. Eaton, president of the American Car & Foundry Company, died in New York on January 28.

The New York office of the Locomotive Stoker Company has been removed from Room 1032, 30 Church street, to Room 1381, 50 Church street.

A. E. Schafer, for the past two years vice-president and general sales manager of the Flint Varnish Works, Flint, Mich., has severed his connection with that company.

The Kilby Locomotive & Machine Works, Anniston, Ala., announces that henceforth the name of the company will be the Kilby Car & Foundry Company. There will be no change in the management of the company.

Benjamin M. Jones, president of B. M. Jones & Co., Inc., Boston, Mass., died at his home in Boston, November 26, age 78 years. Mr. Jones early entered the metal importing business, and dealt largely in railroad specialties.

The Harrison Safety Boiler Works, Philadelphia, Pa., announces that the company received a gold medal for the combined open feed water heater and hot water meter, known as the Cochrane Metering Heater, which is exhibited at the Panama-Pacific Exposition.

R. L. Mason, for fourteen years manager of the railroad department of Hubbard & Co., Pittsburgh, Pa., has severed his connections with that company, effective January 1, to go into the railroad supply business on his own account, with offices at 1501 Oliver building, Pittsburgh.

H. N. Turner, formerly eastern representative of the Kay & Ess Company, Dayton, Ohio, has been appointed sales manager of the company with headquarters at Dayton, and J. W. Wilson has been appointed eastern railway representative of the company, succeeding Mr. Turner.

Flint & Chester, Inc., New York, have opened an office in the People's Gas building, Chicago, from which they will handle in the west the National Graphite Lubricators for which the company is general sales agents in the United States nad Canada. D. J. Lewis has been appointed manager of the Chicago office, effective February 1.

Charles A. Liddle, who has been elected vice-president of the Haskell & Barker Car Company, Inc., was educated in the Philadelphia public schools and commenced his business career as an employee of the Allison Manufacturing Company, of Philadelphia, Pa., builders of freight cars and manufacturers of boiler tubes. Except for a short interval, he has been identified with the car manufacturing business ever since that time, having been successively in the service of the Jackson & Sharpe Company and the Harlan & Hollingsworth Company, at Wilmington, Del., and the Pressed Steel Car Company, at Allegheny, Pa. Since 1901 he has been connected with the American Car & Foundry Company, first as an engineer and later as assistant to the vice-president and general manager, with office at Chicago, which position he has just resigned.

C. A. Liddle

James M. Buick, second vice-president of the American Car & Foundry Company, will be elected first vice-president of the company, succeeding Edward F. Carry, who recently resigned to accept the position of president of the Haskell & Barker Car Company. Herbert W. Wolff, assistant to Mr. Buick, has been made vice-president in charge of the Chicago sales department.

Paul Sutcliffe has been appointed advertising manager of the Edison Storage Battery Company, Orange, N. J. Mr. Sutcliffe joined the Edison interests in 1912, but resigned at the end of a year to become secretary of the W. S. Hill Advertising Company, Pittsburgh, Pa. He has been in the advertising department of the Edison Storage Battery Company for the past year.

David A. Crawford, who has been elected treasurer of the Haskell & Barber Car Company, Inc., New York and Michigan City, Ind., was born at St. Louis, Mo., on April 1, 1880. He attended the public and high schools at Tuscaloosa, Ala., and graduated from the University of Wisconsin with the degree of bachelor of arts in 1905. He remained at the university as an instructor until 1907, when he came to Chicago to become private secretary to E. F. Carry, vice-president of the American Car & Foundry Company. In 1912 he was elected assistant secretary of the American Car & Foundry Company, and continued in that position until January 13th, 1916, when he was elected treasurer of the Haskell & Barker Car Company, Inc.

D. A. Crawford

John E. Dixon, who has recently assumed his duties as vice-president in charge of sales of the Lima Locomotive Corporation, was from February, 1907, until his election to his new position, assistant manager of sales of the American Locomotive Company. Mr. Dixon was born at Milwaukee, Wis., September 11, 1877. He received his education in the common and high schools of that city and at the University of Wisconsin, from which he graduated in 1900 with the degree of mechanical engineer. In the fall of 1900 he entered the employ of the Brooks Works at Dunkirk, N. Y., and served his time in the shops and drawing office. He was later for a while in the mechanical engineer's office, but then went back to the shops, first as foreman of the cylinder shop, then as assistant general machine shop foreman and finally general in-

J. E. Dixon

spector for the Brooks Works. He was transferred to New York in 1905 and made a salesman of the Atlantic Equipment Company, a subsidiary of the American Locomotive Company. He later became manager, but in February, 1907, was transferred to the sales department of the American Locomotive Company as assistant manager of sales as above noted. As vice-president in charge of sales of the Lima Locomotive Corporation, Mr. Dixon will have headquarters at 50 Church street, New York.

The Economy Devices Corporation, New York, has opened a western office at room 1634, McCormick building, under the management of Joseph Sinkler. Mr. Sinkler has been in the service of the Franklin Railway Supply Company for nearly twelve years. He was born at Scranton, Pa., December 14, 1874. He began his mechanical career with the Dickson Locomotive Works, Scranton, Pa., with which company he remained three years. He later was in the employ of the New York, Susquehanna & Western for two years and for a succeeding two years in that of the Delaware, Lackawanna & Western. He became associated with the Franklin Railway Supply Co. on July 1, 1904.


J. Sinkler

J. H. Guess, who has recently been elected secretary and treasurer of the Lima Locomotive Corporation, was from January, 1912, until recently, general purchasing agent of the Grand Trunk. Mr. Guess was born near Raleigh, N. C., on February 5, 1878. He began railway work as a telegraph operator in 1895, on the Seaboard Air Line. From May, 1900, to February, 1901, he was clerk to the vice-president and general manager of the Seaboard Air Line, and from February, 1901, to March of the following year was clerk to the vice-president and general manager of the Atlanta, Birmingham & Atlantic. He was appointed assistant general purchasing agent of the National Railroad of Mexico in March, 1902, and in 1905 was made also assistant secretary and assistant treasurer of that company. From September, 1905, to September, 1910, he was general purchasing agent of the National Railroad of Mexico, and its successor, the National Railways of Mexico. Mr. Guess went to the Grand Trunk as assistant general purchasing agent in 1910, and in Jan- agent as above noted. In addition to being secretary and treas- uary, 1912, was promoted to the position of general purchasing urer of the Lima Locomotive Corporation, Mr. Guess will also be in charge of purchases. His headquarters will be at Lima, Ohio.


J. H. Guess

J. E. Tesseyman, who recently assumed the duties of general manager of the Youngstown Steel Car Company, successor of the Youngstown Car & Manufacturing Co., as noted in the January number of the *Railway Mechanical Engineer,* was formerly vice-president and general manager of the Ralston Steel Car Company. Mr. Tesseyman was born in Dayton, Ohio. After leaving high school in 1893, he entered the services of the Barney & Smith Car Company, and worked in the machine shop and drafting departments of that organization until 1900. He then went to the Pressed Steel Car Company, and served until 1906 as head of the order department, general storekeeper and head of the cost bureau, respectively. In that year he entered the employ of the Ralston Steel Car Company as general superintendent. After three years in that position he was made general manager, and later vice-president and general manager, which position he held until March, 1914.


J. E. Tesseyman

John A. Hill, president of the Hill Publishing Company, died suddenly of heart failure on January 24 while in an automobile on his way from his home in East Orange, N. J., to his place of business in New York City. Mr. Hill was only 57 years of age; he was born February 22, 1858, at Sandgate, near Bennington, Vt. His parents moved to central Wisconsin and settled at Mazomanie when he was still a boy. He received only a country school education, and at 14 years of age went to work in a country printing office, of which he became foreman three years later. He was also half owner of a machine shop. At 20 he spent about a year prospecting and roughing it in the lead district. He then became a fireman on the Denver & Rio Grande and after a year was made an engineer. In his spare moments he took the opportunity of studying railway work and mechanics and occasionally, beginning in 1885, contributed articles to the railway engineering department of the American Machinist. In 1887 the publishers of that paper, desiring to broaden out into a new field, started the Locomotive Engineer. Mr. Hill was invited to New York to become its editor, but after three and a half years in that position he, in company with Angus Sinclair, bought the paper and renamed it Locomotive Engineering.


John A. Hill

The new paper was a success from the start and two notable series of stories that appeared in it and attracted great attention were "Jim Skeever's Object Lessons" and Stories of the Railroad," both of which were afterwards reprinted in book form.

Mr. Hill at this time also published "Progressive Examinations for Locomotive Engineers," later adopted by the Master Mechanics' Association as a standard form of examination.

In 1896 the publishers of Locomotive Engineering, desiring to try their hand at a broader field than their paper would permit, acquired the American Machinist. A year later Mr. Hill sold his interest in Locomotive Engineering to his partner, Mr. Sinclair, and became the sole owner of the American Machinist itself. In 1902 he further extended his activities and purchased Power, which at that time was a monthly journal devoted only to the field of power transmission. The paper was at once changed to its present form and in 1908 it became a weekly. In 1905 the Engineering and Mining Journal was acquired, and in 1911 Coal Age was established to cover a field which was too large to be reached successfully by the Engineering and Mining Journal alone. The Engineering News, the fifth paper now owned by the Hill Publishing Company, was acquired in 1912. In the meantime, in 1900, a British company was formed to publish a European edition of the American Machinist. The continued growth of that paper also led its publishers to establish in 1909 the Deutscher Hill Verlag, A. G., which publishes Maschinenbau, a German edition of the paper.

One of the achievements of which Mr. Hill was proudest, however, was the building at Tenth avenue and Thirty-sixth street, New York, which was completed in the latter part of 1914 and now houses the offices and printing plant of the five Hill publications.

Mr. Hill was recognized by all as one of the leaders and big men of the technical publishing field. It was owing to his initiative that many of the things that now give the technical papers their present standing were brought about. He was by nature modest, but he had the winning qualities of being genial, fond of good companionship, a man of force and character. The present high standing of the Hill Publishing Company, which he founded, is the best evidence of his creative and organizing ability.

Oliver C. Gayley, vice-president of the Pressed Steel Car Company, died at his home in New York City, Sunday, January 9, Mr. Gayley had been associated with the company since December, 1902, and its vice-president since January, 1910. He was born in West Nottingham, Cecil County, Md., April 9, 1860. In 1880 he entered the engineering department of the Pennsylvania railroad, and remained with that road for eight years. In 1888 he became one of the division engineers of the Philadelphia & Reading, but left railway service two years later to accept a position as general manager of the Kansas City Car & Wheel Company, Kansas City, Mo. He later became general agent of the Missouri Car & Foundry Company of St. Louis, from which position he resigned in April, 1893, to enter the service of the Safety Car Heating & Lighting Company, New York. In December, 1902, he became associated with the Pressed Steel Car Company as manager of sales, eastern district. In October, 1904, he was elected second vice-president, and in January, 1910, became vice-president. Mr. Gayley was also vice-president and a director of the Western Steel Car & Foundry Company, and a director of the Safety Car Heating & Lighting Company.

O. C. Gayley

CATALOGUES

Car Door Fasteners.—Circular No. 54, recently issued by the National Malleable Castings Company, Cleveland, Ohio, describes and illustrates the company's line of National safety car door fasteners, handles, stops and fittings.

Horizontal Gas Engines.—The National Transit Company, Oil City, Pa., has issued Bulletin No. 403, describing its horizontal gas engines ranging from 30 to 80 h. p. The book is illustrated with photographs and drawings of the various parts.

Freight Cars.—The Ralston Steel Car Company, Columbus, Ohio, has recently issued a loose-leaf binder containing copies of bulletins showing cars which this company has built for various railroads and other owners of freight cars. Each bulletin illustrates one or more cars and gives a very brief description and general information relative to each. The illustrations are extremely clear, and the binder and its contents very attractively gotten up.

Water Tube Boilers.—The A. D. Granger Company, New York, has just published Bulletin No. 2, sixth edition, describing its Oswego internally fired water-tube boiler. The bulletin, which is well illustrated, describes the latest improved features of this self-contained internally fired water-tube boiler. Dimensions, ratings and other data are given for both high-pressure and low-pressure boilers, and pictures of the detailed parts of the Vulcan shaking grates are shown.

Fireproof Floors and Bearing Partitions of Pressed Steel Construction.—This pamphlet issued by the Trussed Concrete Steel Company, Youngstown, Ohio, illustrates the use of a form of fire-resisting construction involving the use of Kahn pressed steel I-beams and H-studs. Fifteen standard sections are provided, of depths varying from 3 to 12 in. and having an appearance somewhat similar to the standard rolled I-beam. They are made of two pressed steel troughs riveted together back to back, the edges of the bases being turned in to a depth of ½ in. The pamphlet illustrates the wide flexibility with which this form of structural material may be applied. In general, it is intended to cover the studs and beams on each side with a metal lath or mesh such as Hy-Rib, to facilitate the application of concrete surfaces.

Inspection and Tests.—The engineering firm of Robert W. Hunt & Co., Chicago, has recently issued a booklet explaining the work of the engineering division of that company's bureau of inspection, tests and consultation. The book goes into some detail concerning the aims of the organization and the duties of its various departmental subdivisions. The company is prepared to make examinations and reports on public utilities, power plants, industrial plants, etc. It may also be called upon for consultation and designing with reference to power plant design, industrial plants and railway equipment. Its construction and testing department, in addition, is in a position to supervise the construction of power and other plants and to supervise also tests of electrical and mechanical apparatus at the manufacturer's works or at the plant after installation.

Chain Drives.—Publication No. 14, recently issued by the Morse Chain Company, Ithaca, N. Y., bears the appropriate title: "A Chain of Evidence." The booklet deals in particular with large power drives. It explains the advantages of silent chain drives and touches upon the superiority of Morse silent chain, mentioning among other things the economies secured through the use of the Morse rocker-joint which differentiates Morse chain from that of other makes. The catalogue contains a number of interesting illustrations, including views of the largest chain drive in the world, a 5,000-hp. Morse drive in the Ox Bow Hydro-Electric Plant, Snake river, Copperfield, Ore., and of the chain drive installation on the 300-hp. McKeen gasolene switching locomotive built for the Motley County Railway.